MOBILE RADIO

MAINTENANCE MANUAL

GE MODEL MVR16HS-SPL VEHICULAR REPEATER
GE MODEL P2BJJ65BEN-SPL PERSONAL UNIT
GE MODEL 351L4A1X SINGLE UNIT CHARGER
GE MODEL 352L4B1X MULTI-UNIT CHARGER

LBI32570B

STATE OF CALIFORNIA

CALIFORNIA HIGHWAY PATROL

CONTRACT NO. 1-80-58-09 DATED APRIL 1, 1980

PURCHASE ORDER NO. 22433 DATED JUNE 4, 1980

GE REQUISITION NO. F201-2640 MBP-02017

GENERAL ELECTRIC

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Channel Guard LBI30894

Single Unit Charger 351L4A1X
Combination LBI30780

Multi-Unit Charger 352L4B1X
Combination LBI30862

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SPECIAL INSTRUCTIONS

The equipment supplied for this requisition incorporates the existing mobile equipment into a Vehicular Repeater System configuration. The additional equipment consists of vehicular repeater radio units and handheld MPR Series personal radio units.

The MASTR® Executive II Vehicular Repeater Radio Units have been modified to operate in conjunction with existing dual receiver MICOR® mobile radio combination and existing control unit. The MPR Series personal radio units are used with the vehicular repeater radio units to extend communication facility away from the fixed mobile radio vehicle.

The Vehicular Repeater System retransmits (repeats) portable-to-base and base-to-portable transmissions to a vehicle operator, using the MPR radio, away from the vehicle. This permits the operator to be in constant contact with other units or networks when it is not feasible to remain with the vehicle.

VEHICULAR REPEATER RADIO UNIT

The vehicular repeater radio unit is a single frequency unit operating on the frequency of 154.905 MHz with a low power (300 milliwatts) transmitter. The receiver is equipped for Channel Guard decode of either of two CG tones (173.8 and 186.2 Hz). The Channel Guard Tone A (173.8 Hz) when decoded activates the mobile radio transmitter to repeat portable-to-base communications. The Channel Guard Tone B (186.2 Hz) when decoded activates an emergency alerting/message function and keys the mobile radio transmitter for a preset time. For additional information refer to the applicable Maintenance Manuals.

A Type 90 encode/decode module operating at 847.5 Hz insures that only one Vehicular Repeater System is active when more than one unit is in the same general vicinity, preventing multiple transmissions and interference. Refer to the applicable Maintenance Manuals for additional information.

Also, when a ST (single tone encode) function is selected, any audio from the vehicular repeater receiver will be muted for the duration of the ST tone.

When the Vehicular Repeater System has not been activated, the mobile radio unit operates on the channel selected on the control unit. When the Vehicular Repeater System is operational, the circuitry in the vehicular repeater radio unit supplemented by inputs from the control unit determines the mobile radio unit channel frequency. The mobile radio channel selected is shown in Table 1.

CONTROL UNIT CHANNEL	MOBILE XMTR ENABLED REPEATING	MOBILE RADIO CHANNEL SELECTED			
		F1	F2	F3	F4
PRI S	X	X			
PRI C			X		
PRI C or S	X	X			
SEC S	X			X	
SEC C					X
SEC C or S	X			X	

Table 1 - Channel Selection of Mobile Radio

The following jumpers should be present on the Logic Board 19C328461G1.

1. A jumper between H1 and H3 for Time-Out-Timer operation on either Base-to-Portable or Portable-to-Base repeat path.
2. A jumper between H6 and H8 to inhibit priority tone burst when another repeater is repeating Portable-to-Base.

Attenuator 19B234024G1 SPL

An Attenuator (nominal 40 dB @ 155 MHz) is connected between J1 of the vehicular repeater receiver and P102 of the RF Output Module to attenuate the receive signal. The Attenuator is shown on Wiring Diagram 19A144343 and Outline Diagram TE1481.

MPR PERSONAL RADIO UNIT

The MPR Personal Radio Unit supplied for this requisition is equipped for two channel operation, two Channel Guard encode tones and an automatic, timed emergency signal transmission capability.

A Fixed Squelch Option is also installed which provides an internal adjustment and eliminates radio user misadjustment of the squelch control.

Four operational modes are possible when using the MPR Personal Radio Unit:

a. Portable-to-base and base-to-portable communications using an enabled Vehicular Repeater System.
b. Portable-to-portable communications without using the Vehicular Repeater System.
c. Portable-to-portable or portable-to-mobile communications on the statewide emergency channel (MPR channel CLE).

d. Emergency signal from portable-to-base through an enabled Vehicular Repeater System.

Controls and indicators for the MPR Personal Radio Unit are shown in Figure 1.

MPR PERSONAL RADIO UNIT MODIFICATIONS

The MPR Personal Radio Unit has been modified using Modification Kit 19A143674G1 and installed as shown on Modifications Instruction 19D432626.

Control Connector Board 19C331066G1

The Control Connector Board is shown on Outline Diagram 19C331066. This board provides the interface facility between the Control Board and the System Board. The wiring is shown on Wiring Diagram 19R601664.

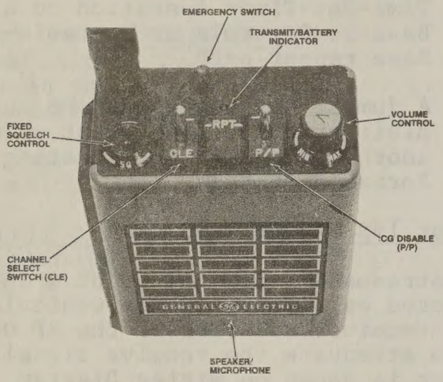

Figure 1 - Controls and Indicators

Control Board 19C331064G1

The Control Board provides the circuitry for the selection of the Channel Guard encode tones, channel selection and the automatic, timed emergency signal transmission. The Control Board is shown on Wiring Diagram 19R601664 and Outline Diagram 19C331064.

Selecting Channel 1 with switch S716 (CLE) applies 7.5 volts to the base of Q1 through CR1. Q1 conducts and applies a low to the SEL 1 line, selecting the channel 1 transmit and receive oscillators.

Selecting channel 2 with switch S716 (CLE) applies 7.5 volts to U1A-1, forcing U1A-3 low and in turn forcing U1B-4 high. This high turns on Q2 and a ground is applied to the SEL 2 line, selecting the channel 2 transmit and receive oscillators. The 7.5 volts at U1A-1 is also applied through CR3 to turn on Q5. Q5 conducting applies a ground to the TONE A OFF line, disabling Channel Guard encode Tone A. No CG Tone A will be transmitted on channel 2 when channel 2 is selected regardless of the position of switch S1001 (see below).

A low from the Channel Guard disable switch S1001 (P/P) forces U1D-11 high. This high causes Q5 to conduct and apply a ground to TONE A OFF line to disable the CG encode Tone A.

A low from the Emergency switch S2991 causes several events to take place which, in turn, interrupts or overrides any of the other three inputs. U3 is a timer that is controlled by the low at U3-2. The momentary low at U3-2 causes a high to appear at U3-3 for approximately 5 seconds. This high turns on Q1, selecting the channel 1 oscillators. At the same time Q3 conducts and applies a low to the PTT line, keying the transmitter. The high also forces U1C-10 low, turning off Q4. This removes the low from the ENC OFF line to CG encoder B and allows the CG encode Tone B to modulate the channel 1 transmit signal.

If channel 2 had been selected when the Emergency switch was activated, the low at U1C-10 forces U1A-3 high. This high then forces U1B-4 low and cuts off Q2, removing the ground from the channel 2 oscillators.

Reset Board 19C331228G1

The Reset Board is shown on Outline Diagram 19C331228 and is connected as shown on Wiring Diagram 19R601664. This board provides the reset signal to the timer U3 whenever power is first applied to the MPR radio unit to prevent possible false operation and transmission of the emergency alert signal.

When the OFF-ON slide switch on the MPR radio unit is placed in the ON position, battery voltage (7.5 VDC) is applied to the 7.5 V bus. On the Reset Board this 7.5 volts forward biases the base of Q18, causing it to conduct and apply a low to the reset input of the timer at U3-4 which in turn keeps the output at U3-3 low.

UDC Cover SPL

A cover has been installed on the UDC accessory jack located on the side rail of the MPR Personal Radio Unit.

MPR PERSONAL RADIO UNIT OPERATION

The MPR Personal Radio Unit is used by a vehicle operator for communications when away from the vehicle mobile radio equipment. The handheld MPR radio can be used in conjunction with the Vehicular Repeater System or for direct portable-to-portable or portable-to-mobile communications.

Vehicular Repeater System Operation

Used in conjunction with an enabled Vehicular Repeater System, the MPR radio user has portable-to-base and base-to-portable communication when away from the vehicle mobile radio equipment. Placing the channel select switch (CLE) and the CG Disable switch (P/P) to the RPT positions selects the channel 1 frequency (154.905 MHz) and Channel Guard encode Tone A (173.8 Hz). For additional details of the Vehicular Repeater System operation refer to the applicable Maintenance Manual.

Direct Communications

The MPR radio units can be used for direct portable-to-portable or portable-to-mobile communications without using the Vehicular Repeater System.

Placing the channel select switch (CLE) to the RPT postion and the CG disable switch (P/P) to the P/P position selects the channel 1 frequency (154.905 MHz) without a Channel Guard encode tone.

To communicate on the statewide emergency channel frequency (154.920 MHz) the channel select switch (CLE) is placed in the CLE position. The CG disable switch (P/P) may be in either position as the channel select switch (CLE) will select the channel 2 frequency with no CG encode tone.

Emergency Signal

The Emergency switch is used to activate an emergency alerting/message signal by an enabled Vehicular Repeater System. The Emergency switch is a momentary action type which, when activated, overrides the existing frequency selection of the MPR radio and automatically transmits a timed emergency signal to an enabled Vehicular Repeater System. The enabled Vehicular Repeater System will then transmit a pre-determined alerting signal/message for a pre-determined lenght of time.

Activating the Emergency switch automatically selects channel 1 frequency (154.905 MHz) and CG encode Tone B (186.2 Hz) and the RF signal is transmitted for approximately 5 seconds. After the emergency signal is transmitted, the MPR radio automatically reverts to the operational mode condition present before the Emergency switch was activated.

NOTE

The following receiver sensitivity specification pertains to the vehicular repeater radio unit receiver. The receiver sensitivity is measured at TP2 on the System Board with the receive signal inserted at the receiver antenna jack J1.

12 dB SINAD (EIA Method)	0.50 uV
20 dB Quieting Method	0.75 uV

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WORLD HEADQUARTERS • LYNCHBURG, VIRGINIA 24502 U.S.A.

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CHANGE NOTICE NO. 1

1. Remove LBI32570A and LBI32569B and replace with LBI32570B and LBI32569C, respectively.
2. Insert diagrams 19A144343 and TE1481 immediately following diagram 19C331228 (see Table of Contents, page ii of LBI32570B).
3. Insert this CHANGE NOTICE NO. 1 immediately following LBI32570B.

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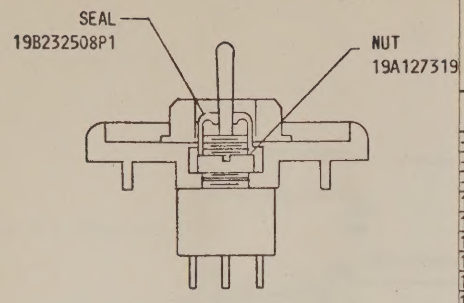
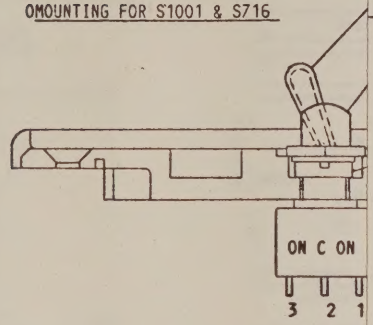
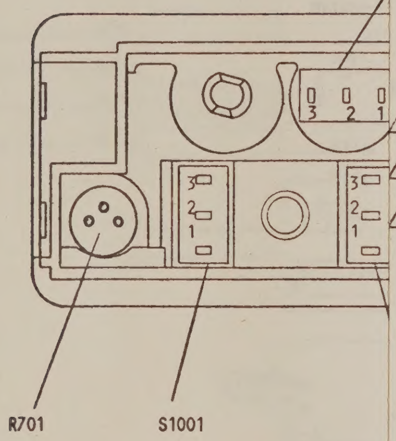


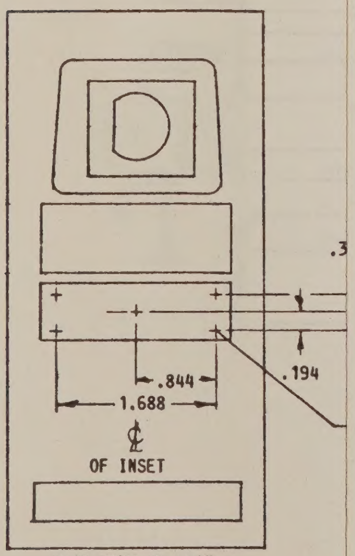
OMOUNTING FOR S1001 & S716



MOUNTING FOR S29



VIEW "A"



REAR VIEW OF UNIT

INSTALLATION OF NP280949P1 AFTER
ADDITIONAL MARKING HAS BEEN ADDED

WIRE CHART

	TO	WIRE	REMARKS
-1	A3591-H6	T28-WBK	
-2	A702-E927	T28-R	
-3	A3591-H5	T28-WO	
1-3	A3591-H3	T28-WR	
1-2	A702-H2	T28-BK	
1-2	A3591-H4	T28-BL	
1-3	A702-H12	T28-BK	
1-H1	E908	T28-WV	
1-H2	E923	T28-O	

THESE MODIFICATION INSTRUCTIONS MODIFY MPR UNIT P2BJJ65BEN USING KIT 19A143674G1.

1. TOP COVER 19D429335P1 TO BE REPLACED WITH TOP COVER 19B233755P1.
2. TOP PLATE 19D429340P1 TO BE REPLACED WITH TOP PLATE 19C331083P1.
3. MAKE WIRE CONNECTIONS PER WIRE CHART & WIRING DIAGRAM.
4. SPECIAL CARE SHOULD BE TAKEN WHEN RUNNING WIRES FOR CONTROL BD. TO PROTECT WIRES FROM ROUGH SOLDER CONNECTIONS AND TRIMMED COMPONENT LEADS.
5. CUT CONNECTOR BOARD 19C331066P1 ALONG DOTTED LINE & CUT EXTENDER RAIL AS SHOWN.

△6 RETURN EXISTING MODULE TO STOCK.

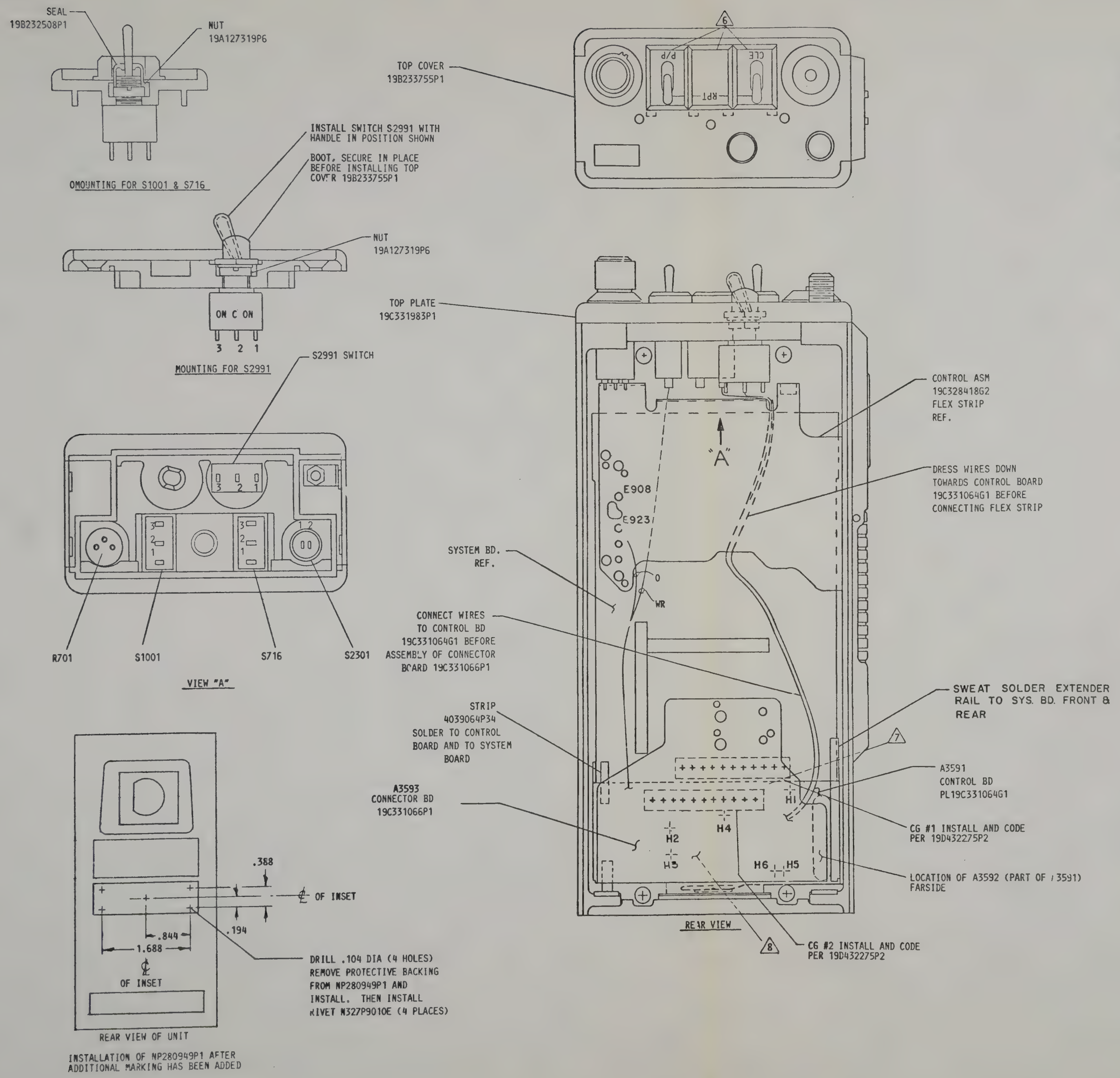
△7 ON FARSIDE, INSERT PAD 19B232682P12 BETWEEN G MODULES #1 & #2.

△8 ON FARSIDE, INSERT PAD 19A143873P1 BETWEEN CG #2 AND BOTTOM PLATE.

MODIFICATION INSTRUCTIONS

MODIFICATION KIT
19A143674G1 (SPL)

(19D432626, Rev. 2)


SEAL
19B232508P1
NUT
19A127319P6
INSTALL SWITCH S2991 WITH HANDLE IN POSITION SHOWN
BOOT, SECURE IN PLACE BEFORE INSTALLING TOP COVER 19B233755P1
NUT
19A127319P6
ON C ON
3 2 1
S2991 SWITCH
3 2 1
3
2
1
3
2
1
1 2
R701
S1001
S716
S2301
.388
.194
.844
1.688
℄ OF INSET
℄
OF INSET
DRILL .104 DIA (4 HOLES) REMOVE PROTECTIVE BACKING FROM NP280949P1 AND INSTALL. THEN INSTALL RIVET N327P9010E (4 PLACES)
6
P/P
RPT
CLE
TOP COVER
19B233755P1
TOP PLATE
19C331983P1
"A"
E908
E923
0
WR
CONTROL ASM
19C328418G2
FLEX STRIP
REF.
DRESS WIRES DOWN TOWARDS CONTROL BOARD 19C331064G1 BEFORE CONNECTING FLEX STRIP
SYSTEM BD.
REF.
CONNECT WIRES TO CONTROL BD 19C331064G1 BEFORE ASSEMBLY OF CONNECTOR BOARD 19C331066P1
STRIP
4039064P34
SOLDER TO CONTROL BOARD AND TO SYSTEM BOARD
A3593
CONNECTOR BD
19C331066P1
SWEAT SOLDER EXTENDER RAIL TO SYS. BD. FRONT & REAR
7
A3591
CONTROL BD
PL19C331064G1
H1
H2
H4
H3
H6
H5
CG #1 INSTALL AND CODE PER 19D432275P2
LOCATION OF A3592 (PART OF A3591) FARSIDE
8
CG #2 INSTALL AND CODE PER 19D432275P2

MOUNTING FOR S1001 & S716

MOUNTING FOR S2991

VIEW "A"

REAR VIEW OF UNIT

INSTALLATION OF NP280949P1 AFTER ADDITIONAL MARKING HAS BEEN ADDED

REAR VIEW

WIRE CHART

FROM	TO	WIRE	REMARKS
S716-1	A3591-H6	T28-WBK	
S716-2	A702-E927	T28-R	
S716-3	A3591-H5	T28-WO	
S1001-3	A3591-H3	T28-WR	
S1001-2	A702-H2	T28-BK	
S2991-2	A3591-H4	T28-BL	
S2991-3	A702-H12	T28-BK	
A3591-H1	E908	T28-WV	
A3591-H2	E923	T28-0	

THESE MODIFICATION INSTRUCTIONS MODIFY MPR UNIT P2BJJ65BEN USING KIT 19A143674G1.

1. TOP COVER 19D429335P1 TO BE REPLACED WITH TOP COVER 19B233755P1.

2. TOP PLATE 19D429340P1 TO BE REPLACED WITH TOP PLATE 19C331083P1.

3. MAKE WIRE CONNECTIONS PER WIRE CHART & WIRING DIAGRAM.

4 SPECIAL CARE SHOULD BE TAKEN WHEN RUNNING WIRES FOR CONTROL BD. TO PROTECT WIRES FROM ROUGH SOLDER CONNECTIONS AND TRIMMED COMPONENT LEADS.

5. CUT CONNECTOR BOARD 19C331066P1 ALONG DOTTED LINE & CUT EXTENDER RAIL AS SHOWN.

6. RETURN EXISTING MODULE TO STOCK.

7. ON FARSIDE, INSERT PAD 19B232682P12 BETWEEN G MODULES #1 & #2.

8. ON FARSIDE, INSERT PAD 19A143873P1 BETWEEN CG #2 AND BOTTOM PLATE.

MODIFICATION INSTRUCTIONS

MODIFICATION KIT
19A143674G1 (SPL)

(19D432626, Rev. 2)

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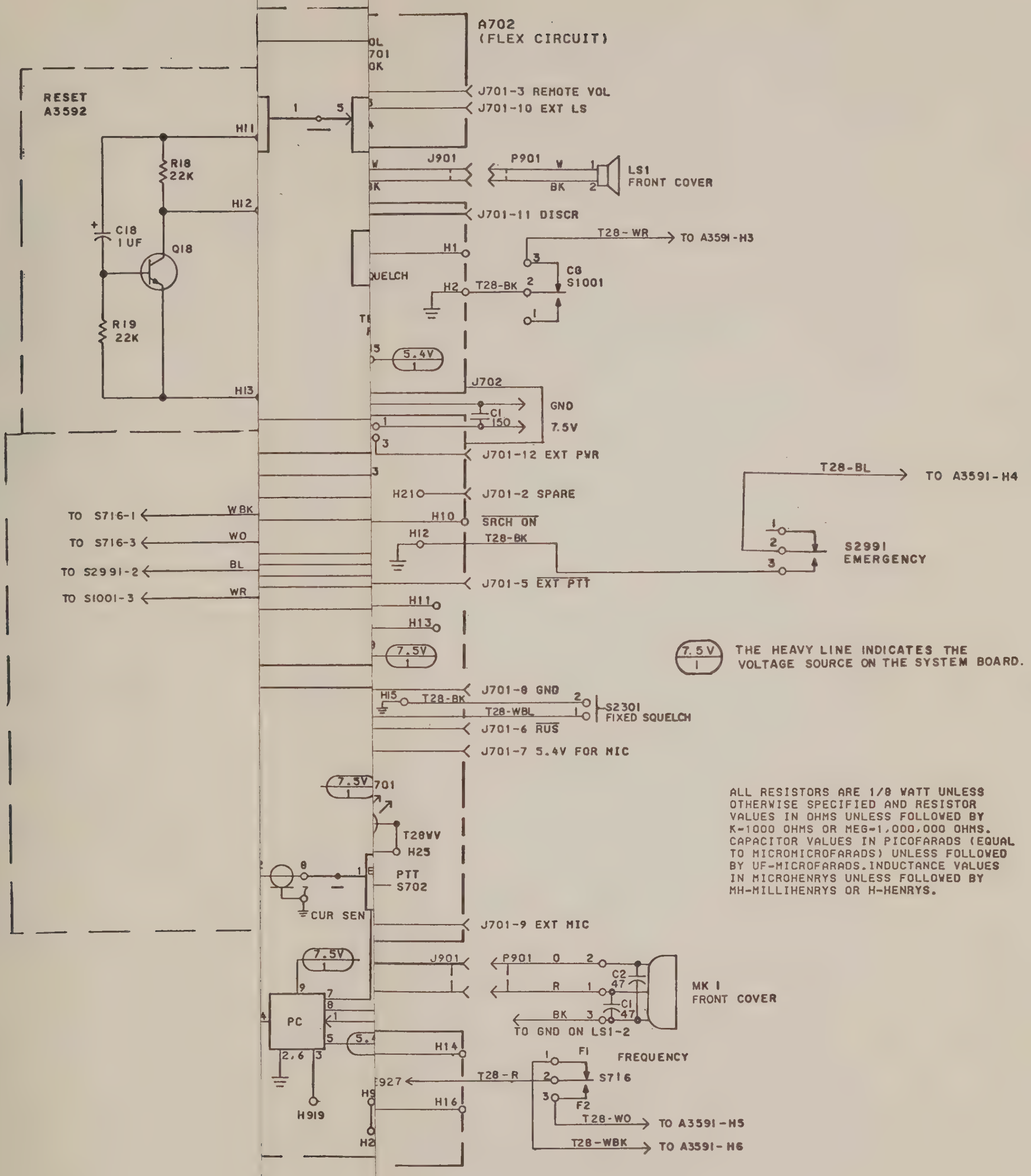

A702
(FLEX CIRCUIT)
RESET
A3592
H11
H12
H13
R18
22K
R19
22K
C18
1 UF
Q18
J701-3 REMOTE VOL
J701-10 EXT LS
J901
P901
LS1
FRONT COVER
J701-11 DISCR
T28-WR
TO A3591-H3
H1
H2
T28-BK
C8
S1001
QUELCH
5.4V
J702
GND
7.5V
C1
150
J701-12 EXT PWR
T28-BL
TO A3591-H4
H21
J701-2 SPARE
TO S716-1
TO S716-3
TO S2991-2
TO S1001-3
WBK
WO
BL
WR
H10
SRCH ON
H12
S2991
EMERGENCY
J701-5 EXT PTT
H11
H13
7.5V
J701-8 GND
H15
T28-WBL
S2301
FIXED SQUELCH
J701-6 RUS
J701-7 5.4V FOR MIC
7.5V
T28WV
H25
PTT
S702
CUR SEN
J701-9 EXT MIC
J901
P901
C2
47
C1
47
MK 1
FRONT COVER
TO GND ON LS1-2
PC
H14
H16
H919
E927
T28-R
FREQUENCY
F1
F2
S716
T28-WO
TO A3591-H5
T28-WBK
TO A3591-H6

7.5V
1

THE HEAVY LINE INDICATES THE VOLTAGE SOURCE ON THE SYSTEM BOARD.

ALL RESISTORS ARE 1/8 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF=MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH=MILLIHENRYS OR H=HENRYS.

WIRING DIAGRAM

SYSTEM BOARD
MPR (SPL)

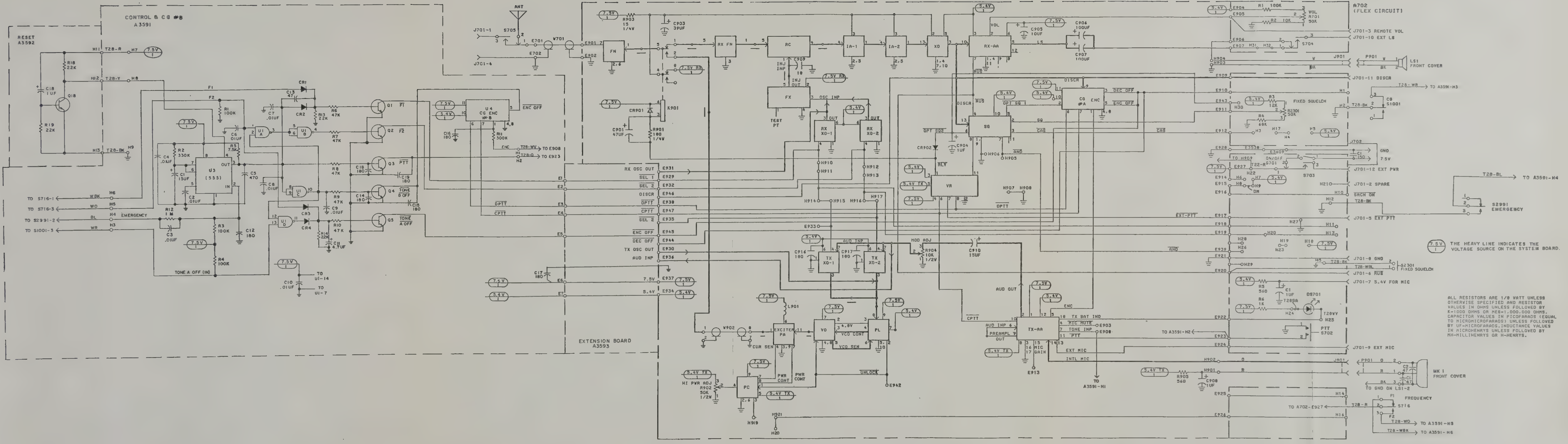
(19R601664, Rev. 3A)

PARTS LIST

MODIFICATION KIT
19A143674G1
ISSUE 2

SYMBOL	GE PART NO.	DESCRIPTION
A3591		CONTROL BOARD 19C331064G1
A3592		RESET BOARD 19C331228G1
		- - - - - - - - - - - CAPACITORS - - - - - - - - - -
C18	19A134202P14	Tantalum: 1 µf ±20%, 35 VDCW.
		- - - - - - - - - - - TRANSISTORS - - - - - - - - -
Q18	19A115910P1	Silicon, NPN; sim to Type 2N3904.
		- - - - - - - - - - - RESISTORS - - - - - - - - - -
R18 and R19	3R151P223J	Composition: 22K ohms ±5%, 1/8 w.
		- - - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	19A134202P108	Tantalum: 15 µf ±20%, 20 VDCW.
C2 and C3	19A116080P1	Polyester: 0.01 µf ±20%, 50 VDCW.
C4	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121 SPECIAL.
C5	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-A050-W5R-471M.
C6 thru C10	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121 SPECIAL.
C11	19A700003P6	Tantalum: 4.7 µf ±20%, 35 VDCW.
C12	19A700229P74	Ceramic: 180 pf ±5%, 100 VDCW.
C13	19A700221P53	Ceramic: 47 pf ±5%, 100 VDCW.
C14 thru C19	19A700229P74	Ceramic: 180 pf ±5%, 100 VDCW.
		- - - - - - - - - DIODES AND RECTIFIERS - - - - - -
CR1 and CR2	19A115100P1	Silicon; sim to Type 1N458A.
CR3 and CR4	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
		- - - - - - - - - - - TERMINALS - - - - - - - - - - -
E1 thru E7	19A134591P1	Contact.
		- - - - - - - - - - - TRANSISTORS - - - - - - - - -
Q1 thru Q5	19A115910P1	Silicon, NPN; sim to Type 2N3904.
		- - - - - - - - - - - RESISTORS - - - - - - - - - -
R1	3R151P104J	Composition: 100K ohms ±5%, 1/8 w.
R2	19A700019P67	Deposited carbon: 330 ohms ±5%, 1/4 w.
R3 and R4	3R151P104J	Composition: 100K ohms ±5%, 1/8 w.
R5	3R151P752J	Composition: 7.5K ohms ±5%, 1/8 w.
R6 thru R10	3R151P473J	Composition: 47K ohms ±5%, 1/8 w.
R11	3R151P304J	Composition: 300K ohms ±5%, 1/8 w.
R12	3R151P105J	Composition: 1 megohm ±5%, 1/8 w.
R13 and R14	3R151P223J	Composition: 22K ohms ±5%, 1/8 w.
		- - - - - - - - - INTEGRATED CIRCUITS - - - - - - -
U1	19A134097P9	Digital, Quad 2-Input Nand Gate: Identification No. 4011.
U3	19A134827P1	Linear, Dual In-Line 8 Pin Mini Dip Package; sim to EXAR XR-L555CN.
U4	19D429618G2	Integrated circuit.
A3593	19C331066P1	Connector Board.
		- - - - - - - - - - - SWITCHES - - - - - - - - - - -
S716	19A116648P6	Toggle: SPDT; sim to C & K Components 7101SDG.
S2991	19A700189P2	Toggle: SPDT; sim to C & K Components 7108G.
		- - - - - - - - - - - MISCELLANEOUS - - - - - - - -
	19B232757P1	Rail.
	19B209648P1	Contact, electrical. (Quantity 5- Located at U4).
	19A115834P9	Contact, electrical; sim to AMP 2-332070-4. (Quantity 2- Located at U4).
	19B232682P12	Pad. (Located between channel guard modules 1 & 2).
	19A143873P1	Pad. (Located between channel guard 2 & bottom plate).
	19B233755P1	Top cover.
	19D429521P1	Cover, channel guard.
	19C331083P1	Top plate.
	5490135P7	Boot. (S2991).
	19B233508P1	Seal. (S716).
	19A127319P6	Nut: 1/4-40. (Used with S716 & S1001).
	19B233834G1	Decorative module. (CLE).
	19B233834G2	Decorative module. (RPT).
	19B233834G3	Decorative module. (P/P).
	4039064P34	Strip. (Soldered to control & system boards).
	19B219681P1	Contact, electrical. (Used with channel guard).
	NP280949	Nameplate.
	N327P9010E	Rivet. (Secures nameplate).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES


RESET A3592
CONTROL & CG #8 A3591
EXTENSION BOARD A3593
A702 (FLEX CIRCUIT)
ANT
U3 (555)
U4 CG ENC #8
FN
RX FN
RC
IA-1
IA-2
XO
RX-AA
FX
RX XO-1
RX XO-2
CG #A
ENC
SQ
VR
TX XO-1
TX XO-2
EXCITER PA
VO
PL
PC
TX-AA
TO S716-1
TO S716-3
TO S2991-2
TO S1001-3
EMERGENCY
TONE A OFF (IN)
RX OSC OUT
SEL 1
SEL 2
DISCR
DPTT
CPTT
ENC OFF
DEC OFF
TX OSC OUT
AUD INP
J701-3 REMOTE VOL
J701-10 EXT LS
LS1 FRONT COVER
J701-11 DISCR
FIXED SQUELCH
J701-12 EXT PWR
J701-2 SPARE
J701-5 EXT PTT
S2991 EMERGENCY
J701-8 GND
S2301 FIXED SQUELCH
J701-6 RUS
J701-7 5.4V FOR MIC
PTT S702
J701-9 EXT MIC
MK 1 FRONT COVER
FREQUENCY
S716
TO A3591-H3
TO A3591-H4
TO A3591-H5
TO A3591-H6
TO A3591-H1
TO A3591-H2
TO A702-E927

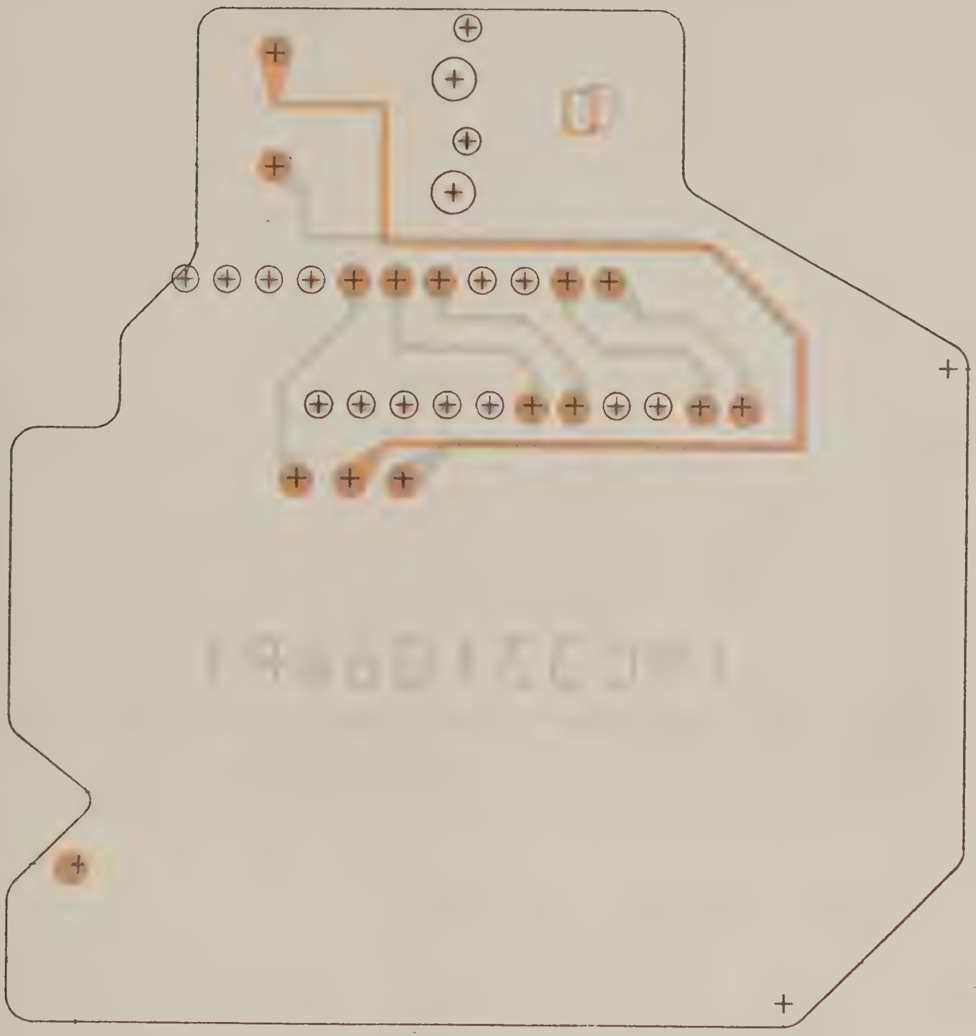
THE HEAVY LINE INDICATES THE VOLTAGE SOURCE ON THE SYSTEM BOARD.

ALL RESISTORS ARE 1/8 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF=MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH=MILLIHENRYS OR H=HENRYS.

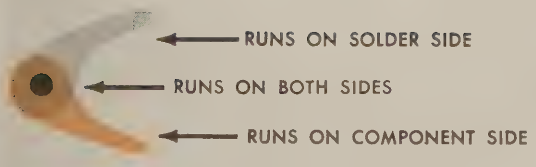
WIRING DIAGRAM

SYSTEM BOARD
MPR (SPL)

(19R601664, Rev. 3A)



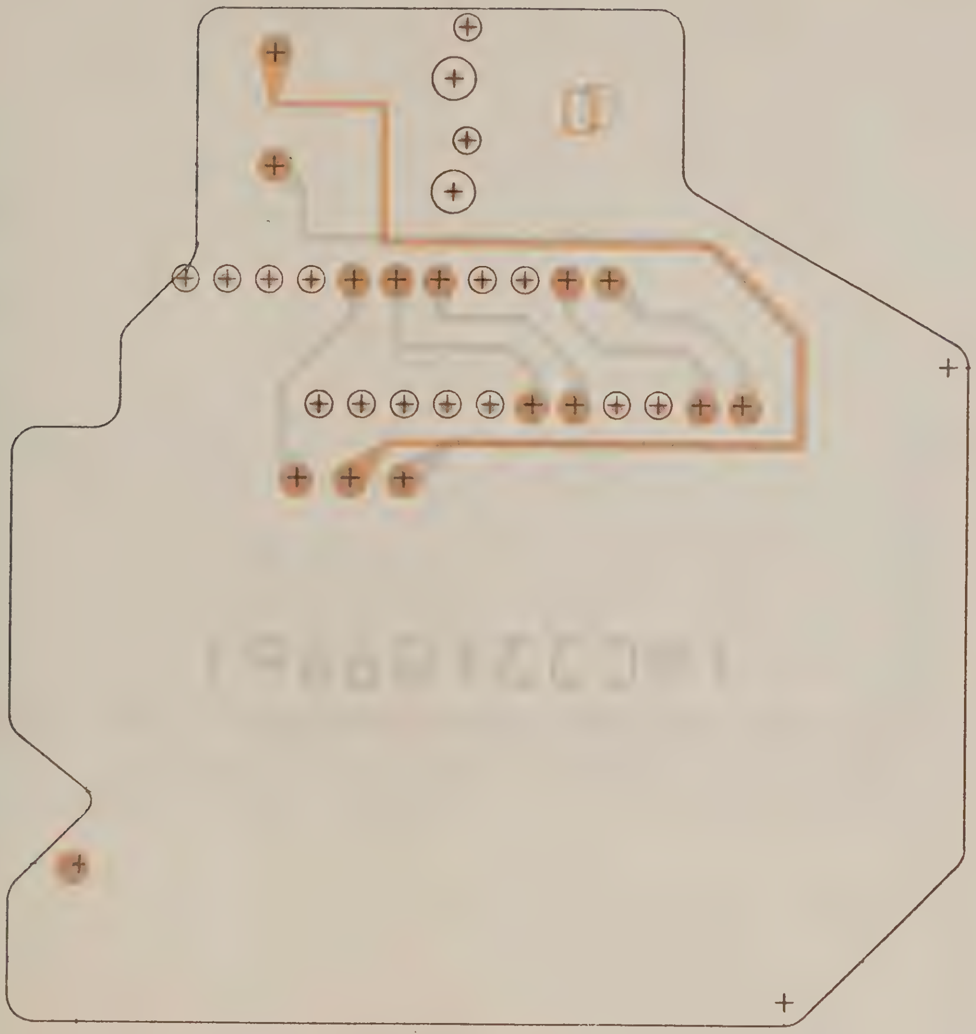
(19C331066, Rev. 0)
(19A143671, Sh. 1, Rev. 0)
(19A143671, Sh. 2, Rev. 0)


RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE

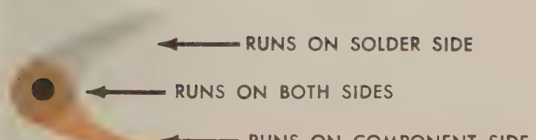
OUTLINE DIAGRAM

CONTROL CONNECTOR BOARD
19C331066G1 (SPL)

(19C331066, Rev. 0)



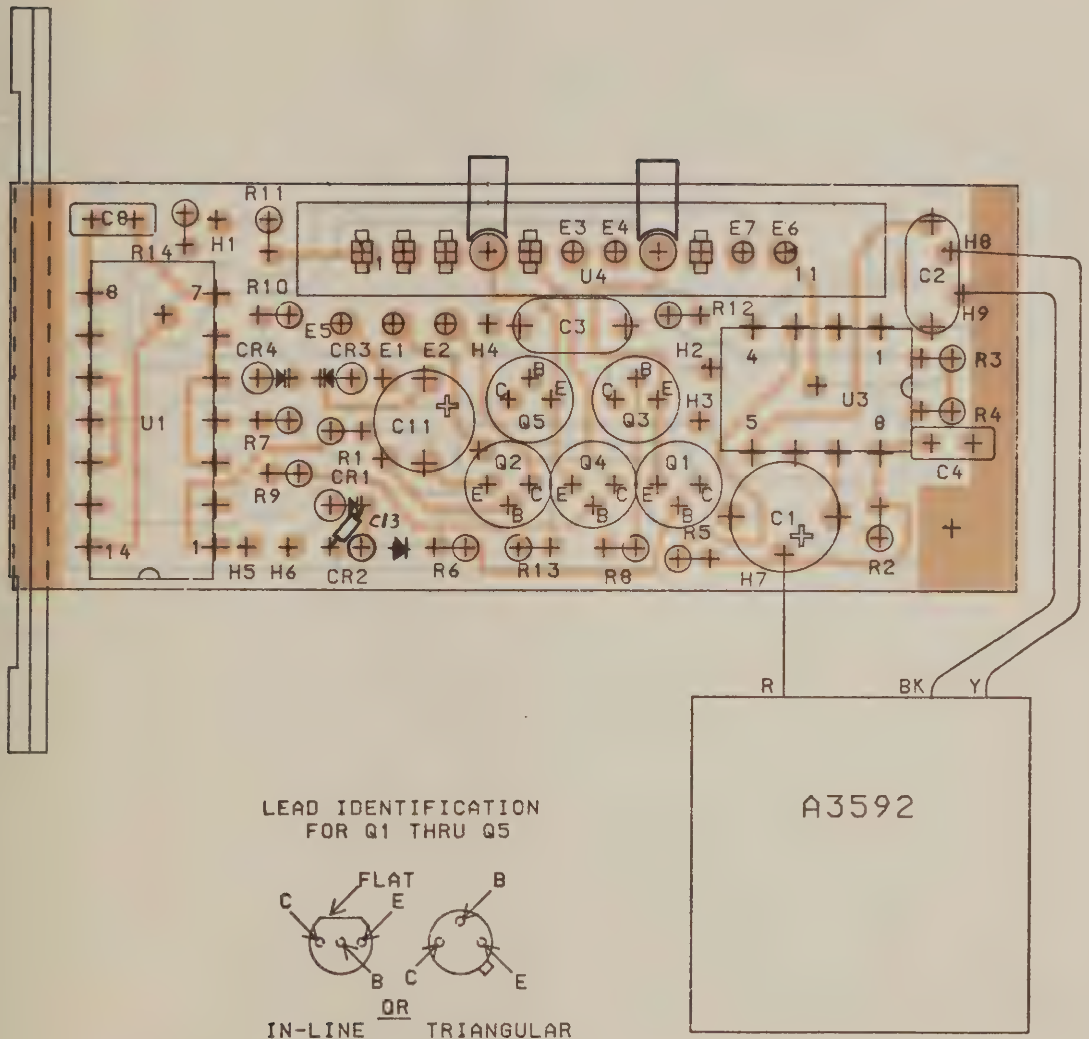
(19C331066, Rev. 0)
(19A143671, Sh. 1, Rev. 0)
(19A143671, Sh. 2, Rev. 0)


RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE

OUTLINE DIAGRAM

CONTROL CONNECTOR BOARD
19C331066G1 (SPL)

(19C331066, Rev. 0)



C8
R11
H1
R14
E3
E4
E7
E6
11
1
U4
H8
C2
H9
8
7
R10
E5
E1
E2
H4
C3
R12
CR4
CR3
H2
4
1
R3
U1
Q5
Q3
H3
U3
R7
C11
5
8
R4
R1
Q2
Q4
Q1
C4
CR1
R9
C13
C1
R5
14
1
H5
H6
CR2
R6
R13
R8
H7
R2
C
B
E
R
BK
Y
A3592

LEAD IDENTIFICATION
FOR Q1 THRU Q5

FLAT
C
E
B
B
C
E

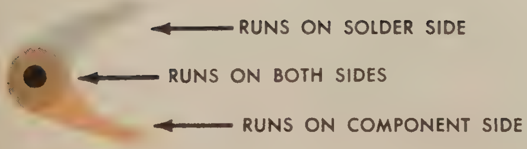
OR

IN-LINE TRIANGULAR

TOP VIEW

NOTE: LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

(19C331064, Sh. 1, Rev. 1)
(19A143673, Sh. 1, Rev. 1)
(19A143673, Sh. 2, Rev. 1)



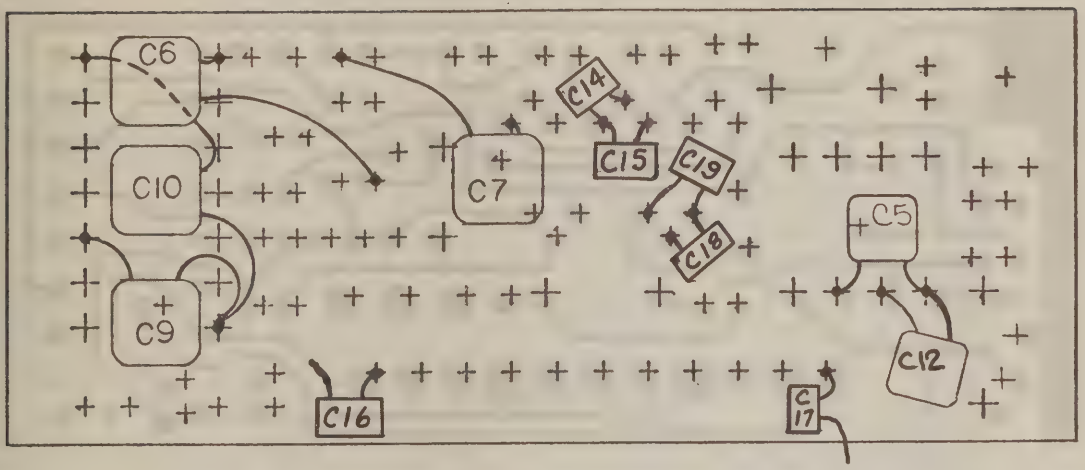
RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE

OUTLINE DIAGRAM

CONTROL BOARD WITH
PWB BOARD REV. 1
19C331064G1 (SPL)

(TE-1469, Sh. 1, Rev. 0)

SOLDER SIDE VIEW


C6
C10
C9
C7
C14
C15
C19
C18
C16
C5
C12
C
17

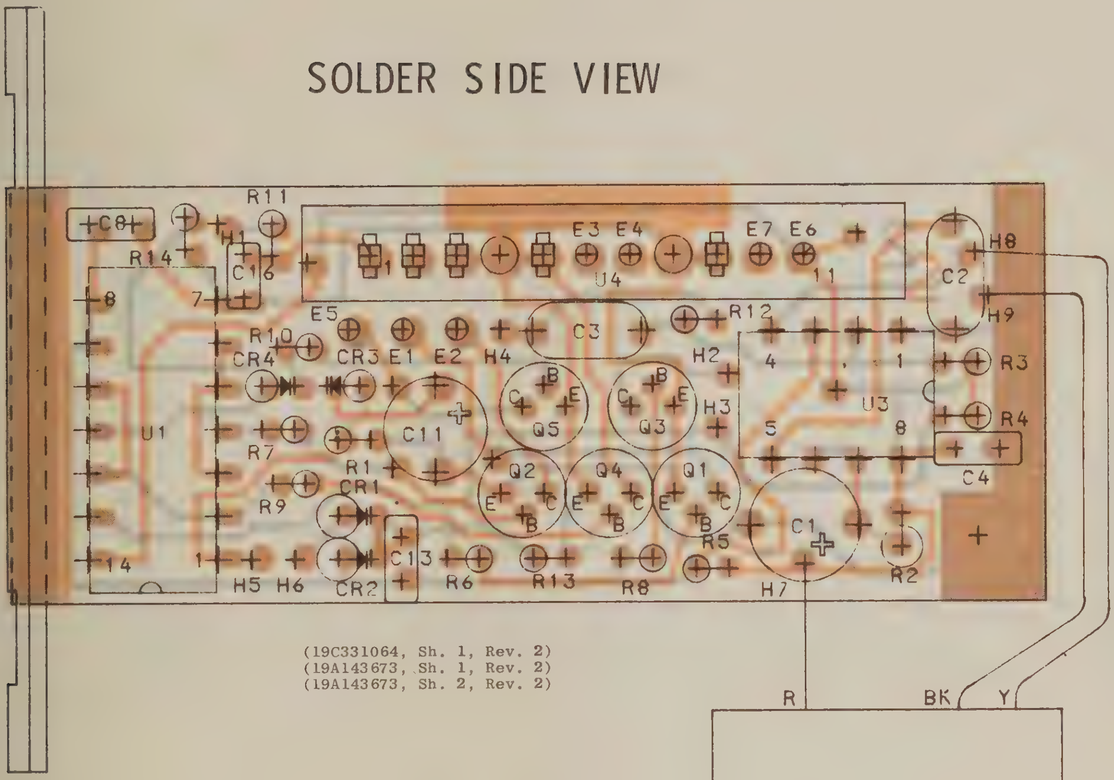
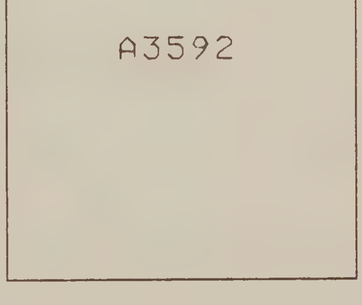
(19C331064, Sh. 2, Rev. 2)
(19A143673, Sh. 2, Rev. 1)

OUTLINE DIAGRAM

CONTROL BOARD WITH
PWB BOARD REV. 1
19C331064G1 (SPL)

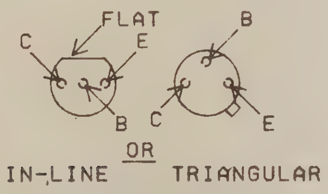
(TE-1469, Sh. 2, Rev. 0)

SOLDER SIDE VIEW



R11
C8
R14
H1
C16
U4
E3
E4
E7
E6
11
1
H8
C2
H9
8
7
E5
R10
CR4
CR3
E1
E2
H4
C3
R12
H2
4
1
U3
R3
R4
U1
C11
Q5
Q3
H3
5
8
C4
R7
R1
Q2
Q4
Q1
CR1
R9
C1
R5
R2
C13
14
1
H5
H6
CR2
R6
R13
R8
H7
B
C
E
R
BK
Y
A3592

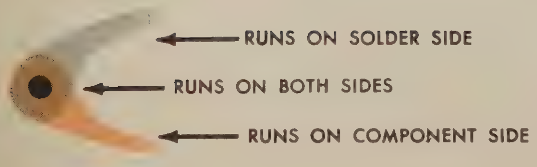
(19C331064, Sh. 1, Rev. 2)
(19A143673, Sh. 1, Rev. 2)
(19A143673, Sh. 2, Rev. 2)

LEAD IDENTIFICATION
FOR Q1 THRU Q5


FLAT
C
E
B
B
C
E
OR
IN-LINE
TRIANGULAR

TOP VIEW

NOTE: LEAD ARRANGEMENT, AND NOT
CASE SHAPE, IS DETERMINING
FACTOR FOR LEAD IDENTIFICATION.

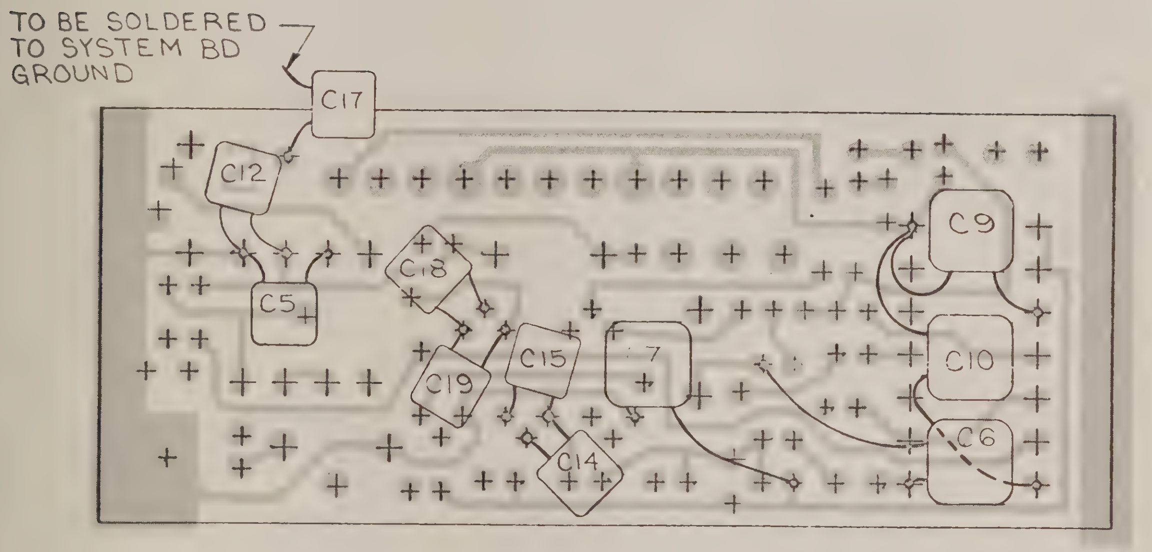

RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE

OUTLINE DIAGRAM

CONTROL BOARD WITH
PWB BOARD REV. 2
19C331064G1 (SPL)

(19C331064, Sh. 1, Rev. 2)

SOLDER SIDE VIEW


TO BE SOLDERED TO SYSTEM BD GROUND
C17
C12
C5
C18
C19
C15
C14
7
C9
C10
C6

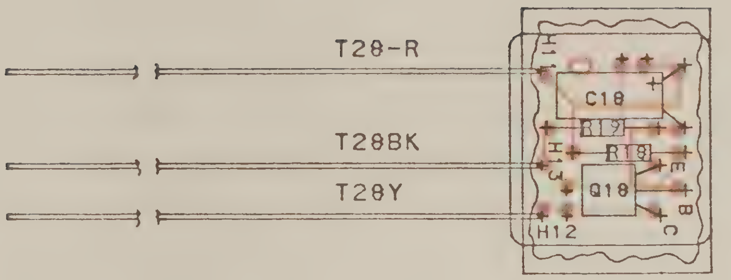
(19C331064, Sh. 2, Rev. 3)
(19A143673, Sh. 2, Rev. 2)

RUNS ON SOLDER SIDE
● RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE

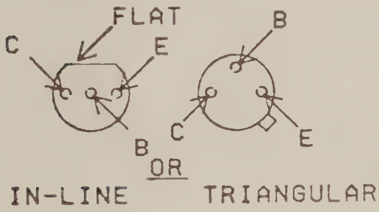
OUTLINE DIAGRAM

CONTROL BOARD WITH
PWB BOARD REV. 2
19C331064G1 (SPL)

(19C331064, Sh. 2, Rev. 3)


T28-R
T28BK
T28Y
H11
H13
H12
C18
R19
R18
Q18
E
B
C

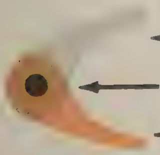
LEAD IDENTIFICATION
FOR Q18


FLAT
C
E
B
B
C
E
OR
IN-LINE
TRIANGULAR

TOP VIEW

NOTE: LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

(19C331228, Rev. 0)
(19A143848, Sh. 1, Rev. 0)
(19A143848, Sh. 2, Rev. 0)

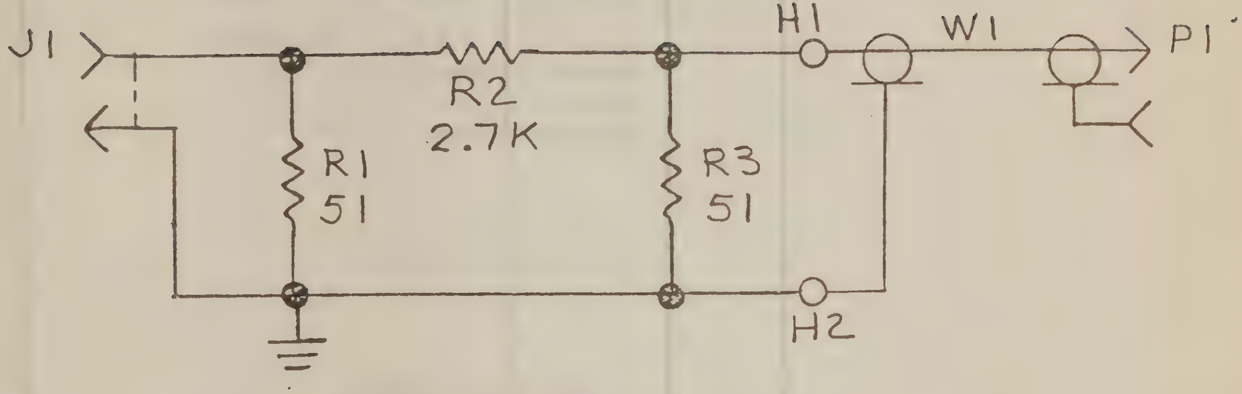


RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE

OUTLINE DIAGRAM

RESET BOARD
19C331228G1 (SPL)

(19C331228, Rev. 0)


J1
R2
2.7K
R1
51
R3
51
H1
W1
P1
H2

ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG = 1,000,000 OHMS.

WIRING DIAGRAM

ATTENUATOR
19B234024G1

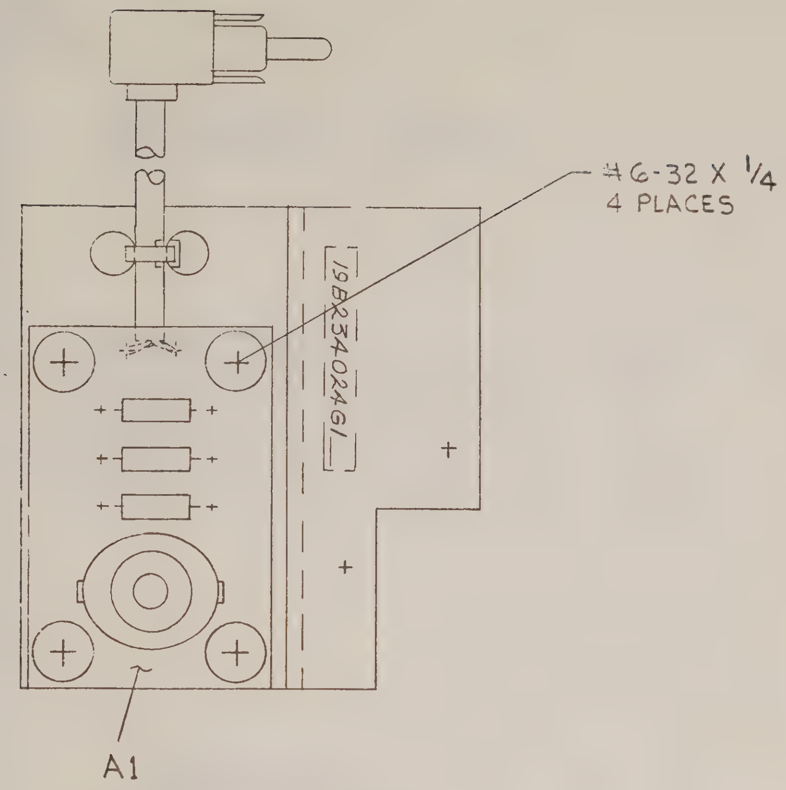
(19A144343, Rev. 1)

PARTS LIST

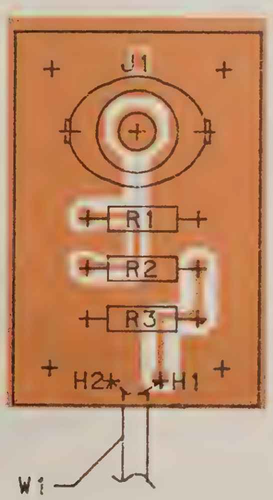
ATTENUATOR
19B234024G1

Issue 2

SYMBOL	GE PART NO.	DESCRIPTION
A1	19C331559G1	Attenuator Board.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	19A700106P32	Composition: 51 ohms 5%, ¼ w.
R2	19A700106P73	Composition: 2700 ohms 5%, ¼ w.
R3	19A700106P32	Composition: 51 ohms 5%, ¼ w.
		- - - - - - - - - - - JACKS - - - - - - - - - - -
J1	19A130924G1	Connector.
		- - - - - - - - - - - CABLE - - - - - - - - - - -
W1	5491689P142	Coaxial, RF: 5.5". (Includes P1).
		- - - - - - - - MISCELLANEOUS - - - - - - - -
	19B234023P1	Support.
	19A115185P5	Strap.
	19B201074P305	Screw.


#6-32 X 1/4
4 PLACES
19B234024G1
A1

(19B234024, Rev. 0)


J1
R1
R2
R3
H2
H1
W1

CONNECTION CHART			REMARKS
H1	W1	CONDUCTOR	ON SOLDER SIDE
H2	W1	SHIELD	ON SOLDER SIDE

(19C331559, Rev. 0)
(19A144329, Sh. 1, Rev. 0)
(19A144329, Sh. 2, Rev. 0)

← RUNS ON SOLDER SIDE
← RUNS ON BOTH SIDES
← RUNS ON COMPONENT SIDE

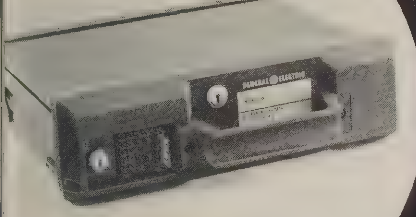
OUTLINE DIAGRAM

ATTENUATOR
19B234024G1

(TE1481, Rev. 0)

MOBILE RADIO

MASTR® *Executive II*
VEHICULAR REPEATER
MAINTENANCE MANUAL LBI 32572A



Mobile Radio

TWO-WAY FM
RADIO

VEHICULAR REPEATER

GENERAL ELECTRIC

TABLE OF CONTENTS

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- Receiver 1
- System Board 1
- Logic Board 1
- Mobile Detector 1

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- Base-To-Portable Adjustments 5
- Portable-To-Base Adjustments 5

OPERATION 6

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- Disassembly 7
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WARNING

Although the highest DC voltage in Vehicular Repeater Equipment is supplied by the vehicle battery, high currents may be drawn under short circuit conditions. These currents can possible heat metal objects such as tools, rings, watchbands, etc., enough to cause burns. Be careful when working near energized circuits!

Copyright © 1980, General Electric Company

SYSTEM SPECIFICATIONS*

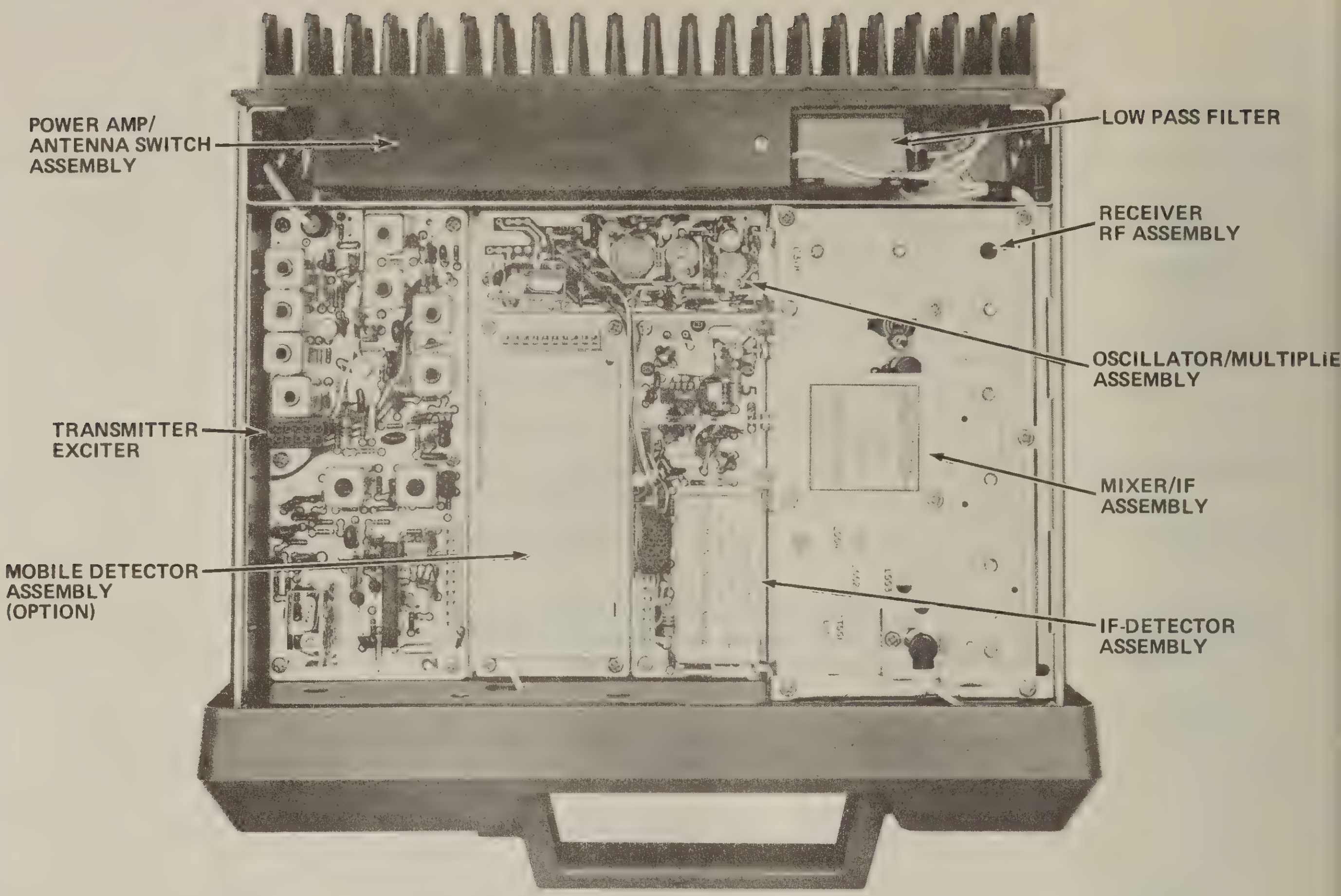
FREQUENCY RANGE	138-174 MHz (KT-169-A)
INPUT VOLTAGE	13.8 VDC ±20%
BATTERY DRAIN	
Off	0.015 Amperes
Standby	0.450 Amperes
Repeat	0.850 Amperes
DIMENSIONS (H x W x D)	9.9 cm/3.9 in. x 34.3 cm/13.5 in. x 34 cm/13.4 in.
WEIGHT	9 kg/20 lbs.
TEMPERATURE RANGE	-30°C to +60°C (-22°F to +140°F)
DUTY CYCLE	Continuous

* These specifications are intended primarily for the use of the serviceman. Refer to the appropriate Specifications Sheet in the applicable MAINTENANCE MANUAL for specifications of standard units in the Vehicular Repeater System.

FCC FILING NUMBER

TRANSMITTER	POWER OUTPUT	FREQUENCY RANGE
KT-169-A	300 Milliwatts	138-174 MHz

TOP VIEW


POWER AMP/
ANTENNA SWITCH
ASSEMBLY
LOW PASS FILTER
RECEIVER
RF ASSEMBLY
OSCILLATOR/MULTIPLIE
ASSEMBLY
TRANSMITTER
EXCITER
MIXER/IF
ASSEMBLY
MOBILE DETECTOR
ASSEMBLY
(OPTION)
IF-DETECTOR
ASSEMBLY

BOTTOM VIEW

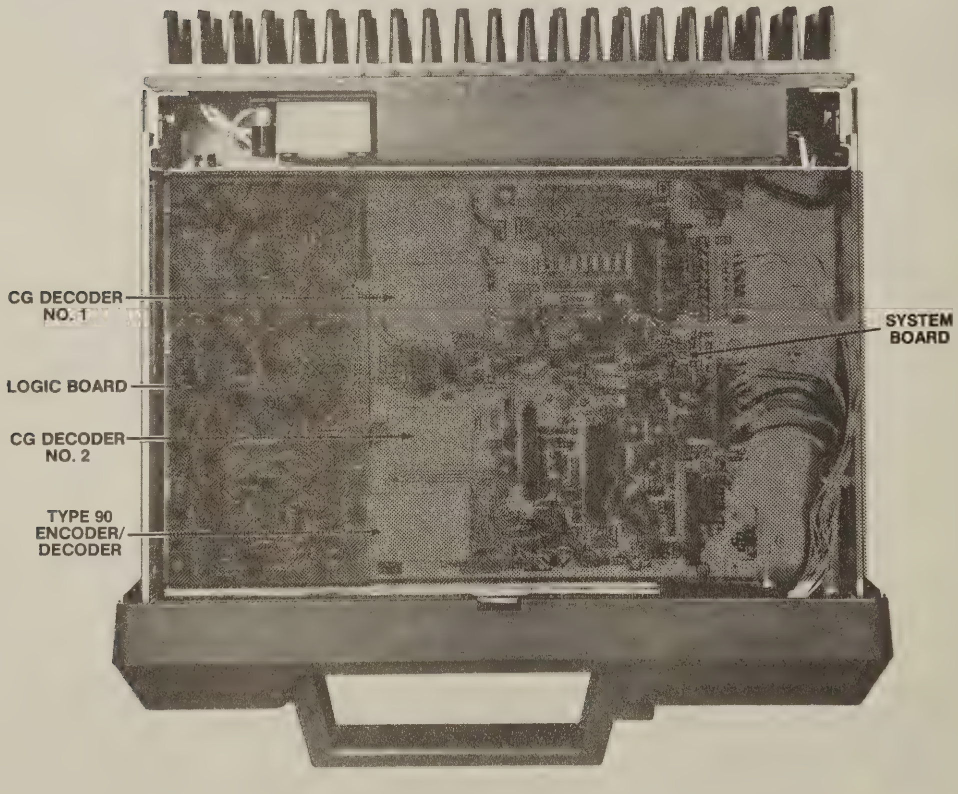

CG DECODER
NO. 1
SYSTEM
BOARD
LOGIC BOARD
CG DECODER
NO. 2
TYPE 90
ENCODER/
DECODER

Figure 1 - Vehicular Repeater Radio Unit Module Layout, (Typical)

DESCRIPTION

MASTR® Executive II Vehicular Repeater Radio Combinations are compact, highly reliable and ruggedly-constructed units that are designed to meet the most stringent requirements in the two-way radio field. The vehicular repeater radio unit operates in conjunction with an existing mobile radio to repeat base-to-portable and portable-to-base transmissions.

The radios are fully transistorized -- utilizing both discrete components and integrated circuits (IC's) for highest reliability. The standard combination is equipped with the following:

- Plug-in oscillator modules for ±0.005% oscillator stability
- Channel Guard (tone squelch) decode
- Type 90 tone encode and decode

The combination is contained in a "slide-rail", tamper resistant mounting frame and is designed for trunk-mount installations. When unlocked, the unit can be easily pulled out of its frame for servicing.

The Vehicular Repeater is of modular construction and the modules may be used interchangeably in vehicular repeater combinations, except for strapping arrangements required for operation in your radio. No modifications are required when transferring the modules from one vehicular repeater to another. All transmit and receive modules are accessible from the top. The system board, logic board, Channel Guard and Type 90 modules are accessible after removing unit from mounting frame.

Centralized metering jacks for the transmitter and receiver are provided for simplified alignment and troubleshooting. Metering test points are available for the System Board and Logic Board measurements.

TRANSMITTER

The transmitter consists of an exciter board and a power amplifier/antenna switch assembly. The PA/antenna switch assembly mounts on a hinged heat sink casting that swings down for easy access. A low-pass filter mounts on the heat sink next to the PA assembly.

RECEIVER

The receiver consists of an oscillator/multiplier assembly (Osc/Mult), RF assembly, Mixer/IF assembly (MIF) and IF-Detector assembly (IF-Det.). The audio and squelch circuitry for the receiver is located on the system board.

SYSTEM BOARD

The system board contains the 10 Volt regulator, frequency select interface, emergency sequence circuitry, repeater squelch, mobile microphone interface, Type 90 interface, repeater CG interface and logic board interface circuit. The board is mounted on the underside of the radio chassis. The system board contains test points to monitor operation of the transmitter, receiver and logic boards as well as for the emergency sequence circuitry.

LOGIC BOARD

The logic board contains the delay state counter circuit, portable interrupt circuit, multiple priority clearing circuit, Type 90 encode timer circuit and a Carrier Control Timer circuit. The board is mounted on the underside of the radio chassis and plugs into the system board.

MOBILE DETECTOR (Not used in this application)

The Mobile Detector is mounted next to the vehicular repeater receiver and monitors the mobile radio transmit frequency to determine if another repeater is repeating portable-to-base transmissions. If there is a portable-to-base transmission in progress, it keeps the delay state counter from counting down and allowing the vehicular repeater to become the priority unit.

VEHICULAR REPEATER SYSTEM DESCRIPTION

The Vehicular Repeater System consists of the MASTR Executive II Vehicular Repeater Radio, a MPR Portable Radio Unit, existing Mobile Radio Unit with control unit and associated Power/Control Interface Cables. The Vehicular Repeater System retransmits (repeats) portable-to-base and base-to-portable transmissions to a vehicle operator, using the MPR radio, away from the vehicle. This permits the operator to be in constant contact with other units or networks when it is not feasible to remain with the vehicle. A block diagram of the Vehicular Repeater System is shown in Figure 2.

The vehicular repeater radio contains the control and logic circuits necessary to transform a vehicle into a mobile repeating station. The vehicular repeater is a single frequency radio operating in the 138-174 MHz frequency range with a low-power (300 milliwatts) transmitter. The antenna for the vehicular repeater will normally be located on the trunk area of the vehicle.

When the Vehicular Repeater System is enabled, the mobile radio is used to repeat

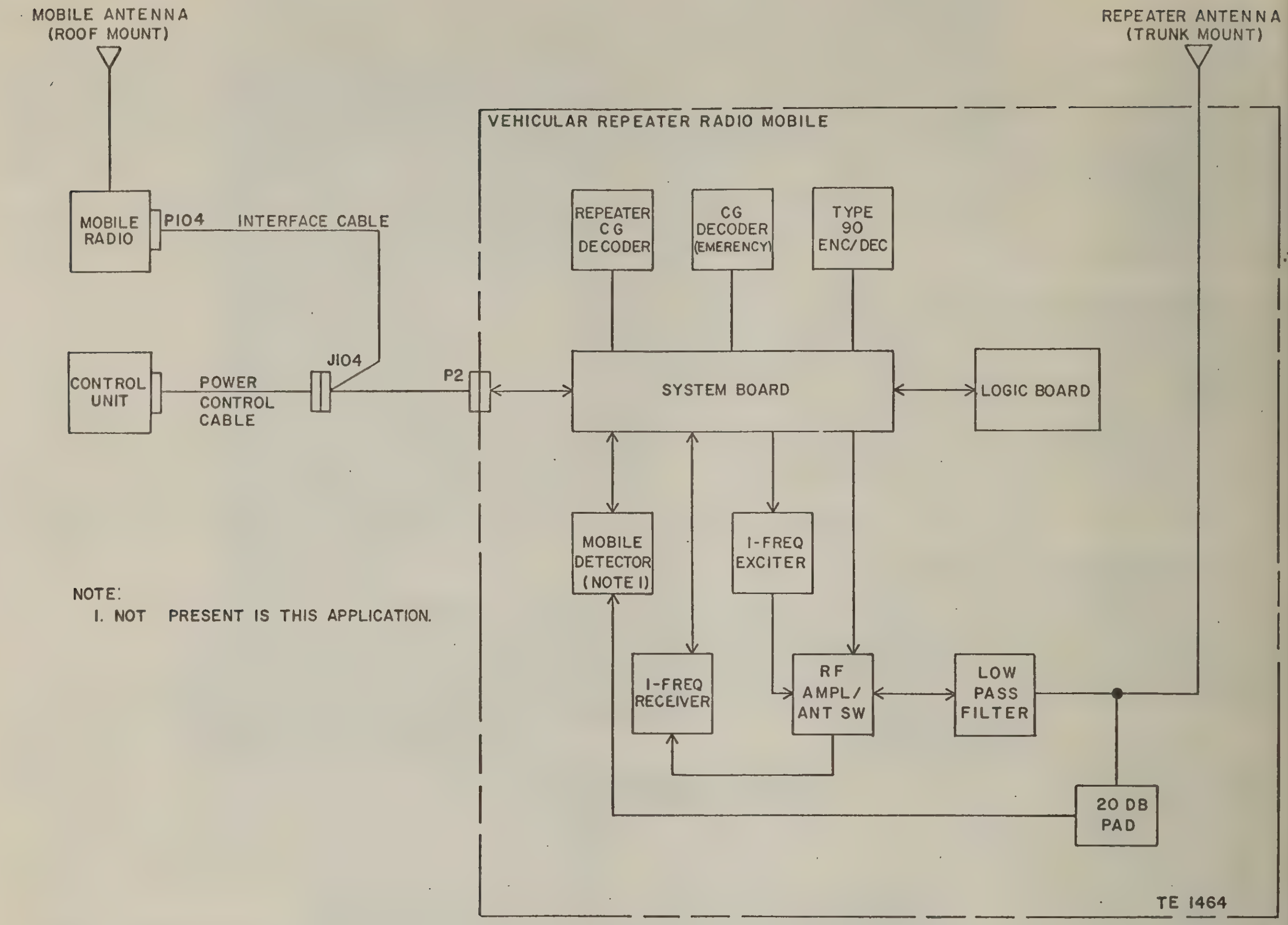

MOBILE ANTENNA
(ROOF MOUNT)
REPEATER ANTENNA
(TRUNK MOUNT)
VEHICULAR REPEATER RADIO MOBILE
MOBILE RADIO
P104
INTERFACE CABLE
REPEATER CG DECODER
CG DECODER (EMERENCY)
TYPE 90 ENC/DEC
CONTROL UNIT
POWER CONTROL CABLE
J104
P2
SYSTEM BOARD
LOGIC BOARD
MOBILE DETECTOR (NOTE 1)
1-FREQ EXCITER
NOTE:
1. NOT PRESENT IS THIS APPLICATION.
1-FREQ RECEIVER
RF AMPL/ ANT SW
LOW PASS FILTER
20 DB PAD
TE 1464

Figure 2 - Vehicular Repeater System Block Diagram

transmissions to and from remote/repeat base stations. This arrangement permits cross-band repeat operation to minimize interference problems and eliminate the requirements for duplexers.

The mobile radio control unit operating in conjunction with the circuits on the vehicular repeater radio system board provides automatic frequency selection for the mobile radio unit.

The MPR radio unit operates in the 138-174 MHz frequency range with a medium power transmitter and uses a flexible spring antenna. A channel select switch permits the selection of two RF channels. Only one frequency/channel is used to communicate via the Vehicular Repeater.

SYSTEM OPERATION

The Vehicular Repeater System extends the communications from a fixed mobile (vehicle) system to a portable communications system permitting the vehicle operator to remain in continuous communication with the dispatch center or other radio system units when away from the vehicle. There are four basic types or modes of operation possible when the operator has left the vehicle with the MPR radio.

One mode is the portable-to-base or base-to-portable operation which uses the Vehicular Repeater System to repeat any transmissions from the MPR portable radio to a remote/repeat base station for communications with a dispatcher or to other mobile radio units via a base station repeater facility. The base-to-portable operation permits a dispatcher(s) or other mobile radio units using a remote/repeat base station to communicate with the MPR portable radio operator through the repeat function of the Vehicular Repeater System.

In portable-to-base operation the Vehicular Repeater System is enabled. When the MPR radio user places the channel select (CLE) and CG Disable (P/P) switches to the

RPT positions and keys the unit, the transmitted signal is modulated with a Channel Guard tone. When this CG tone is detected by the CG decoder #1 in the vehicular repeater radio unit, the control and logic circuits key the mobile radio unit to repeat the message.

In the base-to-portable operation the signal is detected by the mobile radio receiver and a control signal applied to the vehicular repeater radio logic and control circuits. The vehicular repeater transmitter is keyed and the audio from the mobile radio receiver is repeated and received by the MPR radio unit(s).

During the portable-to-base and base-to-portable operations, all MPR radios in the area will hear each other's transmissions directly and the repeated reply from the base station.

The Vehicular Repeater System is interrupted when the mobile microphone is used. When the mobile PTT switch is operated, the repeat function is disabled and the mobile radio is used for communications. When the mobile microphone use is concluded, the Vehicular Repeater System will again be available for the repeat function.

The second mode of operation involves the MPR radios for portable-to-portable communications without activating the Vehicular Repeater System. The portable-to-portable channel uses the same RF frequency as the Vehicular Repeater System channel but does not contain a CG encode tone. When the MPR radio user places the channel select (CLE) switch to the RPT position and the CG disable (P/P) switch to the P/P position, the Channel 1 frequency is selected without a CG encode tone. Since the RF signal does not contain a CG tone, it cannot activate the Vehicular Repeater System. However, all MPR radios in the area and on the designated channel will hear the transmissions.

The third mode of operation is used for portable-to-portable or portable-to-mobile communications without activating the Vehicular Repeater System and operates on the statewide emergency channel frequency. Placing the channel select (CLE) switch to the CLE position selects the Channel 2 frequency. The position of the CG disable (P/P) switch has no affect on this mode of operation. All MPR radios in the area and on the designated channel will hear the transmissions.

The fourth mode of operation is associated with the emergency alerting function of the MPR radio. Should the situation arise when the MPR radio user must send an emergency alerting signal in lieu of a voice message from the MPR radio, the emergency switch can be activated momentarily. The Vehicular Repeater System must be enabled before this function can be completed. Activating the emergency switch automatically keys the MPR radio transmitter for approximately five seconds on the Channel 1 frequency which is modulated with a CG tone B. In the vehicular repeater unit the CG decoder #2 detects this CG tone and the emergency alerting circuit on the vehicular repeater radio system board is activated. These logic circuits key the mobile radio unit which sends an emergency alerting/message signal to the base station for a pre-determined time. This emergency alerting/message signal has priority over any other audio being repeated by the mobile radio unit and the audio will be muted until the emergency alerting/message signal has been transmitted. This emergency alert sequence is automatically repeated four more times (total of five times).

Control logic circuitry is provided by the vehicular repeater radio to insure that only one Vehicular Repeater System is active when more than one unit is in the same general vicinity, thereby preventing multiple transmissions and interference. The priority logic circuits assure that the last Vehicular Repeater System enabled normally becomes the priority unit and will remain until another unit is enabled or the priority unit leaves the area.

Refer to the applicable Maintenance Manuals for additional information.

Enable of First Vehicular Repeater System

When a vehicle containing the Vehicular Repeater System equipment arrives at a location that requires the operator to be away from the vehicle and yet maintain communication, the Vehicular Repeater System can be enabled. The vehicular operator will activate (turn on) the Vehicular Repeater System and the mobile radio unit will operate on the channel selected on the control unit and by the circuitry in the vehicular repeater radio unit. The MPR radio channel select (CLE) switch and CG disable (P/P) switch should be set to the RPT positions.

Turning on the Vehicular Repeater System causes a repeat enable signal to be applied to the logic circuitry in the vehicular repeater radio. This, in turn, causes the vehicular repeater transmitter to send a short burst of Type 90 tone. Since no other Vehicular Repeater Systems have been enabled at this time, the Type 90 tone burst has no effect. At the time of the Type 90 tone burst, the delay state counter in the enabled Vehicular Repeater is reset from a priority state "3" to priority state "0", making this vehicular repeater the priority unit at this location.

Enable of Second Vehicular Repeater System

When a second vehicle, equipped with a Vehicular Repeater System, arrives in the general proximity of the first vehicle, nothing will happen until the repeater system in the second vehicle is enabled. Upon enabling of the second Vehicular Repeater System, the second vehicular repeater transmitter sends a short burst of Type 90 tone. This tone is received by the first vehicular repeater receiver and detected by its Type 90 decoder. The decoder output informs the logic and control circuits of the first vehicle that the second Vehicular Repeater System is assuming control and will become the priority vehicular repeater. The delay state counter in the first vehicular repeater will advance to priority state "1" while the delay state counter in the second vehicular repeater advances to priority state "0". Transmissions to and from all MPR radios in the area will now be repeated by the second Vehicular Repeater System.

NOTE

The MON button on the control unit must be depressed when more than one repeater is enabled.

Enable of Additional Vehicular Repeater Systems

The arrival of additional vehicles with Vehicular Repeater Systems in the same general proximity of the last enabled priority vehicular repeater has no effect on the priority Vehicular Repeater System until the newly arrived Vehicular Repeater Systems are enabled. The delay state counter in each vehicular repeater insures that the last Vehicular Repeater System enabled will be the priority unit.

Departure of Vehicular Repeater System Vehicles

The order in which vehicular repeaters leave a location determines whether the priority changes. A vehicle that leaves or disables its Vehicular Repeater System and was not the priority unit has no effect on the remaining Vehicular Repeater Systems. Should the operator of a priority Vehicular Repeater System disable his vehicular repeater nothing will happen until a condition to repeat occurs. When this condition occurs, the remaining enabled Vehicular Repeater Systems begin to count down from their priority states. The first Vehicular Repeater System to reach priority state "0" becomes the priority unit and repeats, stopping the countdown in the remaining repeaters.

Portable Interrupt

During base-to-portable transmissions, the vehicular repeater transmitter is unkeyed for 6 milliseconds every 2 seconds to check for portable radio transmissions. If there is activity on the portable radio frequency, the vehicular repeater will immediately cease transmitting. If there is a transmission with Channel Guard tone, the vehicular repeater immediately stops repeating base-to-portable and repeats portable-to-base.

Multiple Priority Clearing

If, for any reason, two or more Vehicular repeaters are in priority state "0", the first base-to-portable transmission longer than two seconds will cause all the repeaters in priority state "0", except one, to stop transmitting. This action is initiated by the portable interrupt function. On a base-to-portable transmission, each vehicular repeater is interrupted every two seconds to check for any portable transmissions. Since the two second interval is generated by a free-running clock, the intervals in the priority units are random. One of the priority units will interrupt before the others, detect the other repeater(s) and shut down. At the end of the base transmission, the interrupted repeater(s) will advance to priority state "1", clearing the system.

INSTALLATION

The Vehicular Repeater radio is installed in the same manner as the MASTR Executive II radio. Refer to the Installation Manual for details.

POWER CONTROL AND INTERFACE CABLE

The Power/Control Interface Cable supplied for this Vehicular Repeater System should be installed as indicated in the Installation Manual with the following exception:

The Interface Cable plug P104 is connected to the mobile radio unit and J104 to the Power/Control Cable from the Control Unit. Plug P2 is connected to the vehicular repeater radio unit.

ADJUSTMENTS

INITIAL ADJUSTMENTS

Preliminary adjustments on the mobile radio and the vehicular repeater radio should be completed as indicated in the applicable Maintenance Manuals. The following adjustment procedures should be performed with the complete Vehicular Repeater System interconnected and power applied.

CAUTION

To prevent possible damage to test equipment when connected directly to the antenna jacks of either the mobile radio or the vehicular repeater radio, directional couplers should be used.

Connect test equipment to the Vehicular Repeater System as shown in Figure 3.

Initial Turn-On

1. Apply power to mobile radio and set Frequency Selector Switch to PRIMARY.
2. Apply power to vehicular repeater radio through the RPTR ON control function.
3. The vehicular repeater a radio should be keyed for a short period of time (1/2 second) as indicated on wattmeter.

BASE-TO-PORTABLE ADJUSTMENTS

Type 90 Encode Modulation Adjustment

1. On vehicular repeater radio System Board connect TP3 to TP6 and TP17 to TP8. Using the deviation meter, measure the Type 90 tone deviation.
2. Adjust R605 on Type 90 Encode/Decode Module as necessary to obtain 3 kHz deviation. Remove jumpers.

Repeater Modulation Adjustment

1. Apply a 1000 µV on frequency signal modulated with 1000 Hz to the mobile radio antenna jack.
2. Adjust RPT MOD ADJ control R3 on vehicular repeater radio system board for ±3 kHz deviation.

PORTABLE-TO-BASE ADJUSTMENTS

Repeater Squelch Adjustment

1. Connect a jumper between TP13 and TP5 on vehicular repeater radio system board.
2. Verify that the mobile radio is keyed.
3. Apply an on-frequency 20 dB quieting signal to the vehicular repeater radio antenna jack.
4. Adjust RPT SQ ADJ control R25 on the vehicular repeater radio system board so that the voltage at test point TP10 switches from less than 1 volt to more than 8 volts.

Mobile Modulation Adjustment

1. Apply an on-frequency 1000 µV signal modulated with 1000 Hz to the vehicular repeater radio antenna jack.
2. Adjust MOB MOD ADJ control R11 on the vehicular repeater radio system board for ±3 kHz deviation on mobile radio transmitter output.
3. Operate ST pushbutton switch on control unit and verify that transmitter deviation decreases 30 dB. Release ST switch.

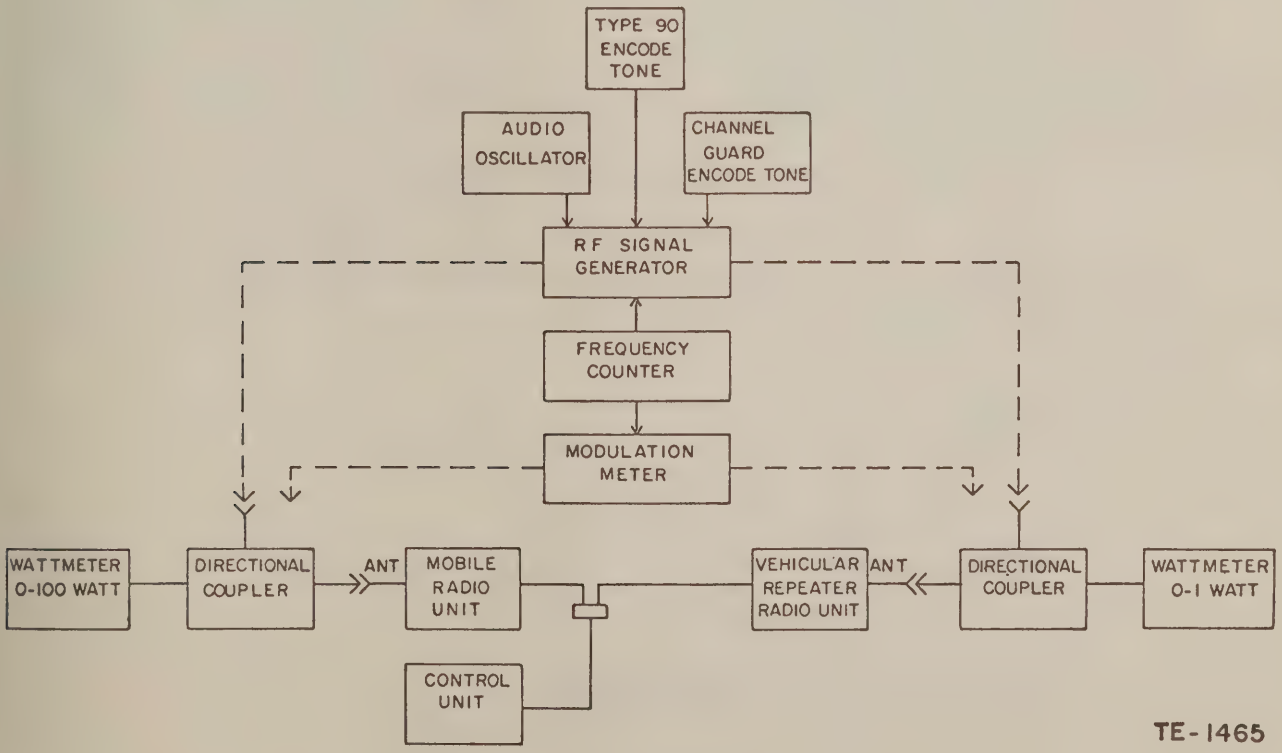

TYPE 90 ENCODE TONE
AUDIO OSCILLATOR
CHANNEL GUARD ENCODE TONE
RF SIGNAL GENERATOR
FREQUENCY COUNTER
MODULATION METER
WATTMETER 0-100 WATT
DIRECTIONAL COUPLER
ANT
MOBILE RADIO UNIT
VEHICULAR REPEATER RADIO UNIT
ANT
DIRECTIONAL COUPLER
WATTMETER 0-1 WATT
CONTROL UNIT
TE-1465

Figure 3 - Test Setup

4. Remove the jumper from TP17 to TP8. Verify that mobile radio transmitter unkeys.
5. Apply an on-frequency signal modulated with proper Channel Guard tone (173.8 Hz) to vehicular repeater radio antenna jack. The mobile radio transmitter should be keyed.
6. Remove the on-frequency signal and the mobile radio transmitter should unkey.
7. Apply a Type 90 tone signal (847.5 Hz) to an on-frequency signal to the vehicular repeater antenna jack. The mobile radio transmitter should not key.
8. Repeat step 6 for 7 times. The mobile radio transmitter should not key.
9. Apply an on-frequency signal modulated with proper CG tone (173.8 Hz) to vehicular repeater radio antenna jack. Mobile radio transmitter should key after a delay of approximately 2 seconds.

Alert Tone Adjustment

1. Jumper TP5 to TP22 and TP26 on vehicular repeater radio system board.
2. Adjust Alert Tone Adjust control R147 on vehicular repeater radio system board for ±3 kHz deviation of keyed mobile radio transmitter.
3. Remove jumper from TP5 to TP22 and TP26.
4. Apply an on-frequency signal modulated with CG tone (186.2 Hz) to vehicular repeater radio antenna jack for approximately 1 second.
5. The mobile radio transmitter should be keyed and modulated with a 1000 Hz tone for the time period indicated in Figure 4. The sequenc should be repeated four more times.

> **NOTE**
>
> Momentary removal of power to the vehicular repeater radio unit will stop the sequence in step 5.

OPERATION

Complete operating instructions for the Two-Way Radio equipment are provided in the separate OPERATING MANUALS. The basic procedures for enabling the Vehicular Repeater System are as follows:

1. Perform the basic procedures for receiving and transmitting messages for the mobile radio unit.

> **NOTE**
>
> The mobile radio should be used for sending and receiving messages when the operator is in the vehicle.

2. Select the applicable channel on the control unit.

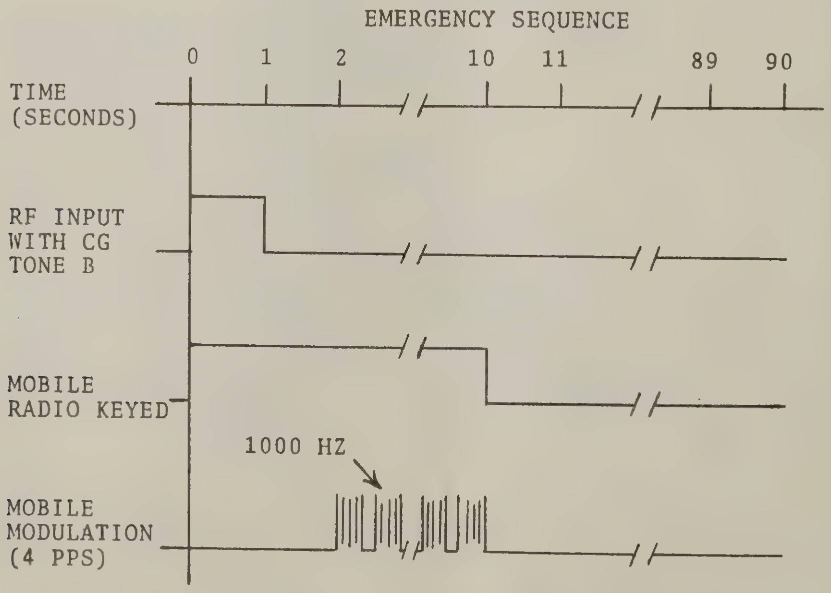


Figure 4 - Emergency Alerting Sequence

3. Apply power to the vehicular repeater radio through the RPTR ON control on/near the control unit.

The Vehicular Repeater System is now enabled and ready to retransmit any communications to and from a vehicle operator while away from the vehicle.

NOTE

REMEMBER - When Vehicular Repeater System is no longer required, the system must be disabled by removing power to the vehicular repeater radio by placing the RPTR ON control to the "off" position.

MAINTENANCE

REMOVING IC's (and all other soldered-in components) can be easily accomplished by using a de-soldering tool such as a SOLDA-PULLT® or equivalent. To remove an IC, heat each lead separately on the solder side and remove the old solder with the de-soldering tool.

An alternate method is to use a special soldering tip that heats all of the pins simultaneously.

CAUTION

The CMOS Integrated Circuit devices used in this equipment can be destroyed by static discharges. Before handling one of these devices, the serviceman should discharge himself by touching the case of a bench test instrument that has a 3-prong power cord connected to an outlet with a known good earth ground. When soldering or de-soldering a CMOS device, the soldering iron should also have a 3-prong power cord connected to an outlet with a known good earth ground or a battery-operated soldering iron should be used.

PREVENTIVE MAINTENANCE

To insure high operating efficiency and to prevent mechanical and electrical failures from interrupting system operations, routine checks should be made of all mechanical and electrical parts at regular intervals. This preventive maintenance should include the checks as listed in the table of Maintenance Checks.

TEST AND TROUBLESHOOTING PROCEDURES

The individual Maintenance Manual for the transmitter and receiver describe standard test procedures which the serviceman can use to compare the actual performance of the transmitter or receiver against the specifications of the unit when shipped from the factory. In addition, specific troubleshooting procedures are available to assist the serviceman in troubleshooting the transmitter and receiver.

DISASSEMBLY

To gain access to the unit for servicing:

1. Unlock the radio (See Figure 5).
2. Loosen the two captive screws shown in Figure 5.
3. Pull the radio forward about two inches out of the mounting frame, and lift off top cover.
4. To gain access to the bottom side, pull the radio all the way out of mounting frame.

MECHANICAL PARTS BREAKDOWN

A mechanical parts breakdown diagram of the vehicular repeater is provided in this manual. The diagram shows the placement and GE Part Number of mechanical items (See Table of Contents).

RE-INSTALLATION

If the mobile combination is ever moved to a different vehicle, always check the battery polarity of the new system.

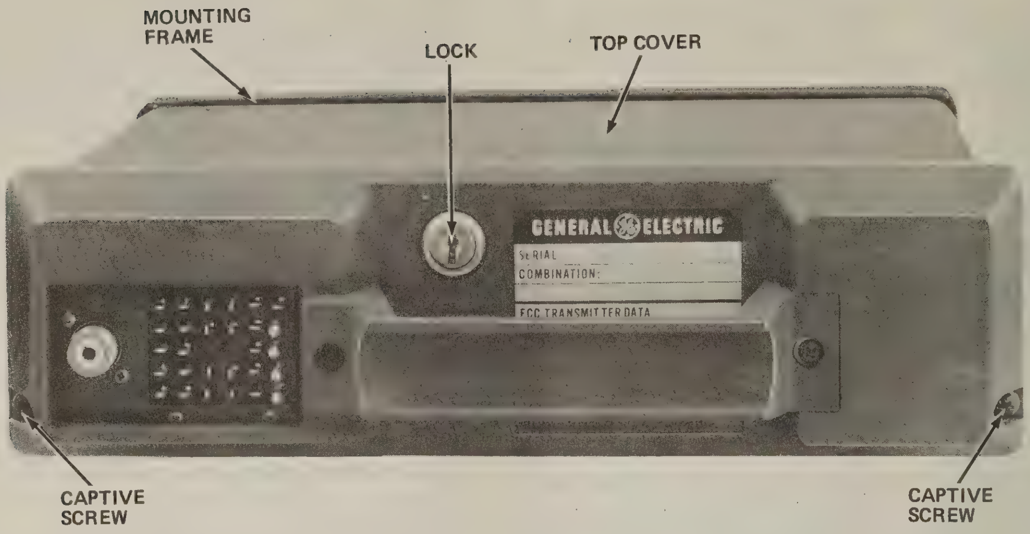

MOUNTING FRAME
LOCK
TOP COVER
GENERAL ELECTRIC
SERIAL
COMBINATION:
FCC TRANSMITTER DATA
CAPTIVE SCREW
CAPTIVE SCREW

Figure 5 - Disassembly

GENERAL ELECTRIC COMPANY • MOBILE COMMUNICATIONS DIVISION
WORLD HEADQUARTERS • LYNCHBURG, VIRGINIA 24502 U.S.A.

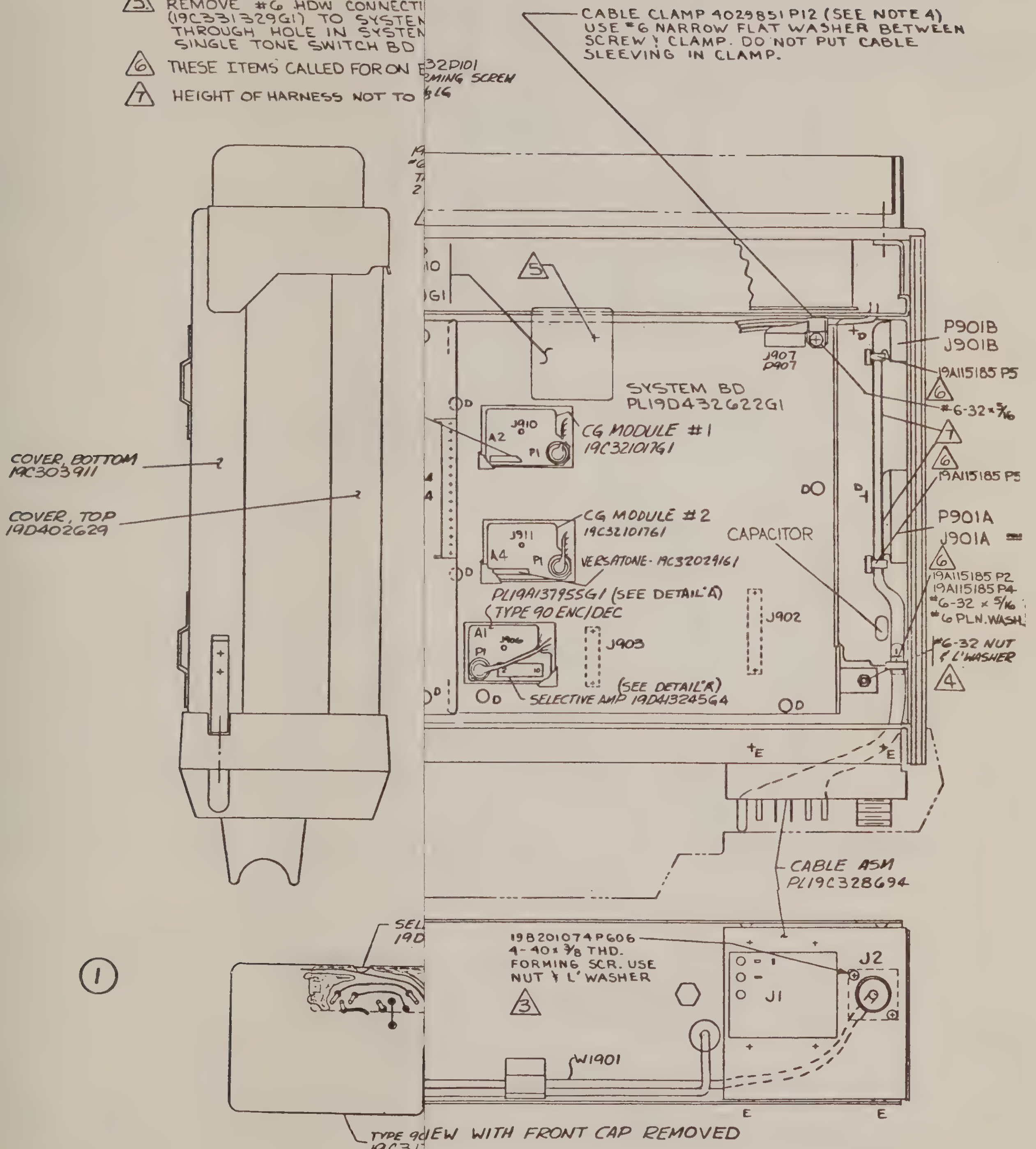
GENERAL ELECTRIC*
U.S.A.

* Trademark of General Electric Company U.S.A.
Printed in U.S.A.

NOTES:

1. SOLDER ALL ELECTRICA
2. PLUG CONNECTOR WITH
   ONTO PLUG WITH RED

3. PART OF HARDWARE KIT PL19
   FOR ON CHASSIS ASM 19
4. APPLY SILICONE GREASE
   HEAT SINK AND CHAS
5. REMOVE #6 HDW CONNECTI
   (19C331329G1) TO SYSTEN
   THROUGH HOLE IN SYSTEN
   SINGLE TONE SWITCH BD
6. THESE ITEMS CALLED FOR ON E
7. HEIGHT OF HARNESS NOT TO


CABLE CLAMP 4029851 P12 (SEE NOTE 4)
USE #6 NARROW FLAT WASHER BETWEEN
SCREW & CLAMP. DO NOT PUT CABLE
SLEEVING IN CLAMP.
32D101
RMING SCREW
316
19
#G
TA
2
10
G1
5
SYSTEM BD
PL19D432622G1
J907
P907
P901B
J901B
19A115185 P5
6
#6-32 x 5/16
7
6
19A115185 P5
J910
A2
P1
CG MODULE #1
19C321017G1
COVER, BOTTOM
19C303911
COVER, TOP
19D402629
A4
A4
J911
A4
P1
CG MODULE #2
19C321017G1
VERSATONE - 19C320291G1
CAPACITOR
P901A
J901A
6
19A115185 P2
19A115185 P4
#6-32 x 5/16
#6 PLN. WASH.
#6-32 NUT
& L'WASHER
4
PL19A137955G1 (SEE DETAIL "A")
(TYPE 90 ENC/DEC
A1
J906
P1
J903
J902
(SEE DETAIL "A")
SELECTIVE AMP 19D413245G4
E
E
CABLE ASM
PL19C328694
SEL
19D
19B201074 P606
4-40 x 3/8 THD.
FORMING SCR. USE
NUT & L' WASHER
3
J2
J1
W1901
E
E
1
TYPE 90
19C31
VIEW WITH FRONT CAP REMOVED

DETAIL "A" (SOL

SOLDER SELECTIV
TYPE 90 ENC/DEC E
SHOWN.

MECHANICAL PARTS BREAKDOWN

MAIN CHASSIS

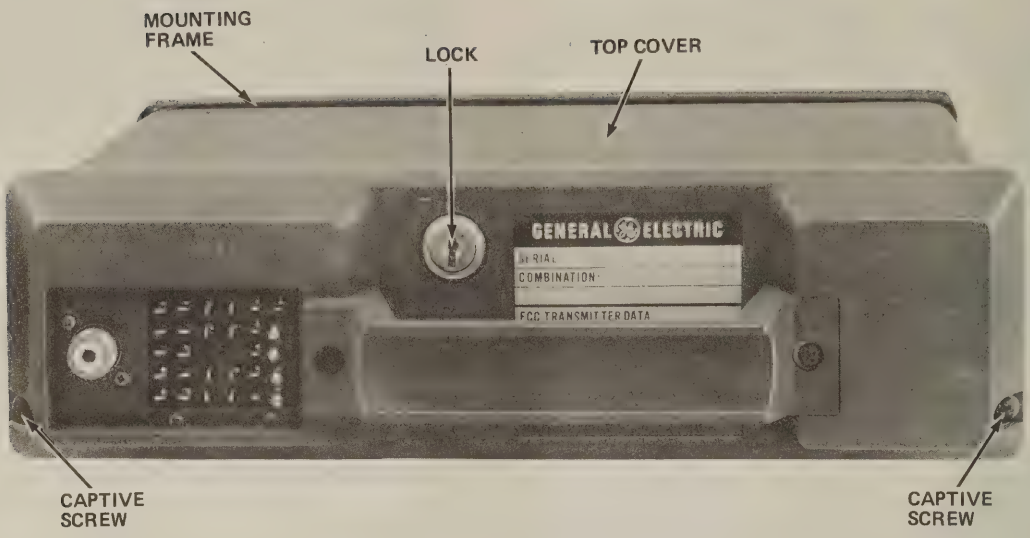

MOUNTING FRAME
LOCK
TOP COVER
GENERAL ELECTRIC
SERIAL
COMBINATION
FCC TRANSMITTER DATA
CAPTIVE SCREW
CAPTIVE SCREW

Figure 5 - Disassembly

GENERAL ELECTRIC COMPANY • MOBILE COMMUNICATIONS DIVISION
WORLD HEADQUARTERS • LYNCHBURG, VIRGINIA 24502 U.S.A.

GENERAL ELECTRIC*
U.S.A.

* Trademark of General Electric Company U.S.A.
Printed in U.S.A.

NOTES:

1. SOLDER ALL ELECTRICAL CONNECTIONS.
2. PLUG CONNECTOR WITH RED SLEEVING ONTO PLUG WITH RED COLOR DOT (J302).

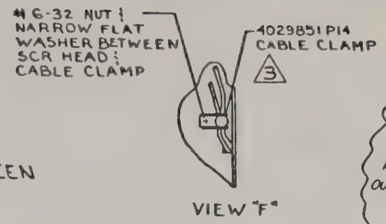
△3 PART OF HARDWARE KIT PL19A130750G1 CALLED FOR ON CHASSIS ASM 19C328697.

△4 APPLY SILICONE GREASE PER PGA-EA111 BETWEEN HEAT SINK AND CHASSIS

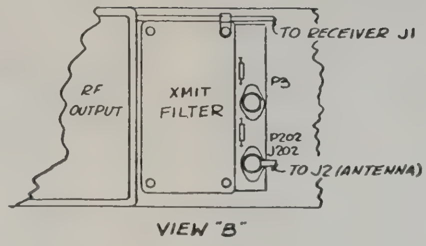
△5 REMOVE #6 HDW CONNECTING SINGLE TONE SWITCH BD (19C331329G1) TO SYSTEM BD. INSTALL SPACER (19B201955P1) THROUGH HOLE IN SYSTEM BD TO CHASSIS. RE-INSTALL SINGLE TONE SWITCH BD WITH #6 SCREW & DISCARD NUT.

△6 THESE ITEMS CALLED FOR ON EN. ORIENTATION AND LOCATION IS CRITICAL.

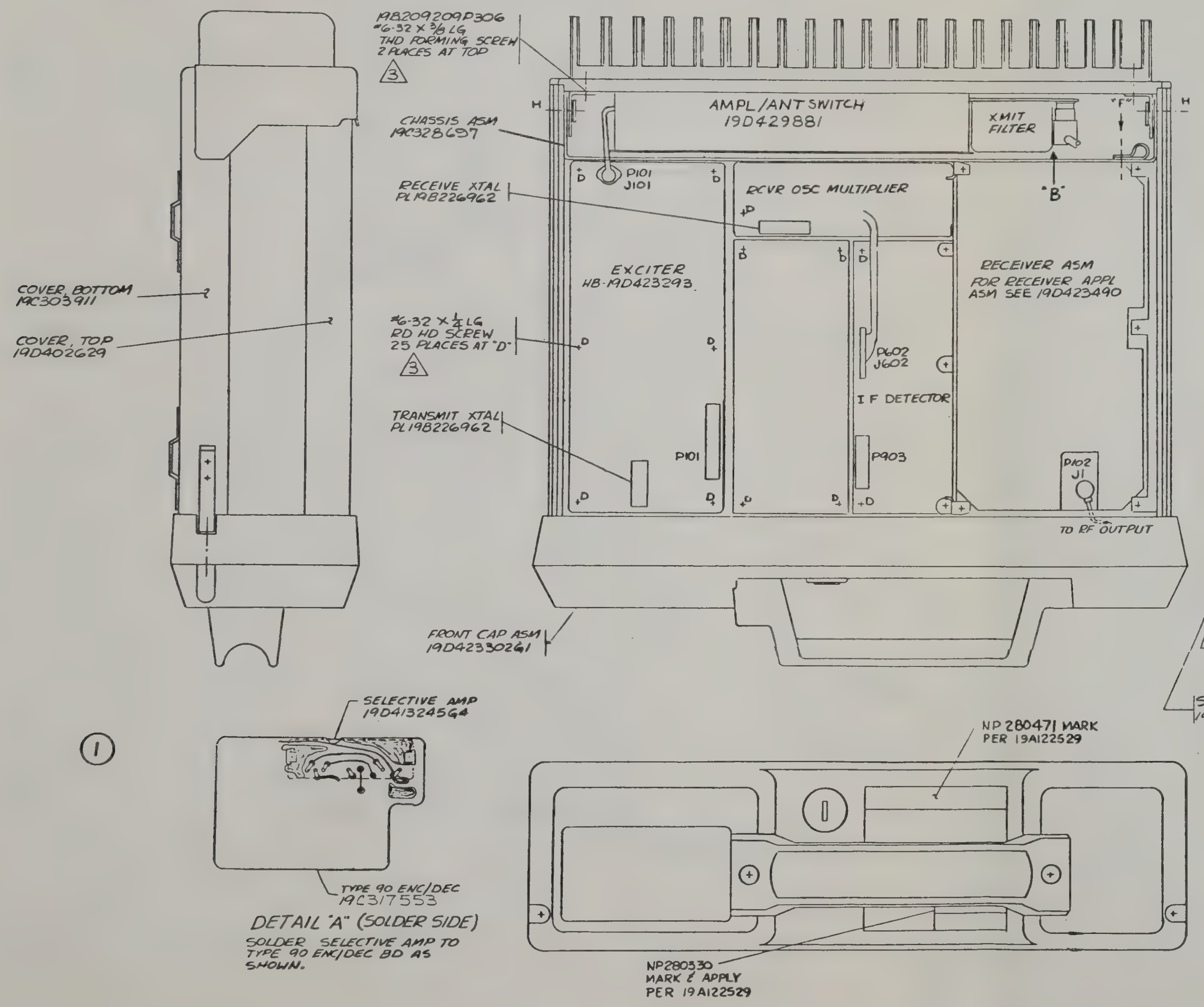
△7 HEIGHT OF HARNESS NOT TO EXTEND ABOVE SIDE PLATE.


#6-32 NUT & NARROW FLAT WASHER BETWEEN SCR HEAD & CABLE CLAMP
4029851 P14 CABLE CLAMP
3

VIEW "F"

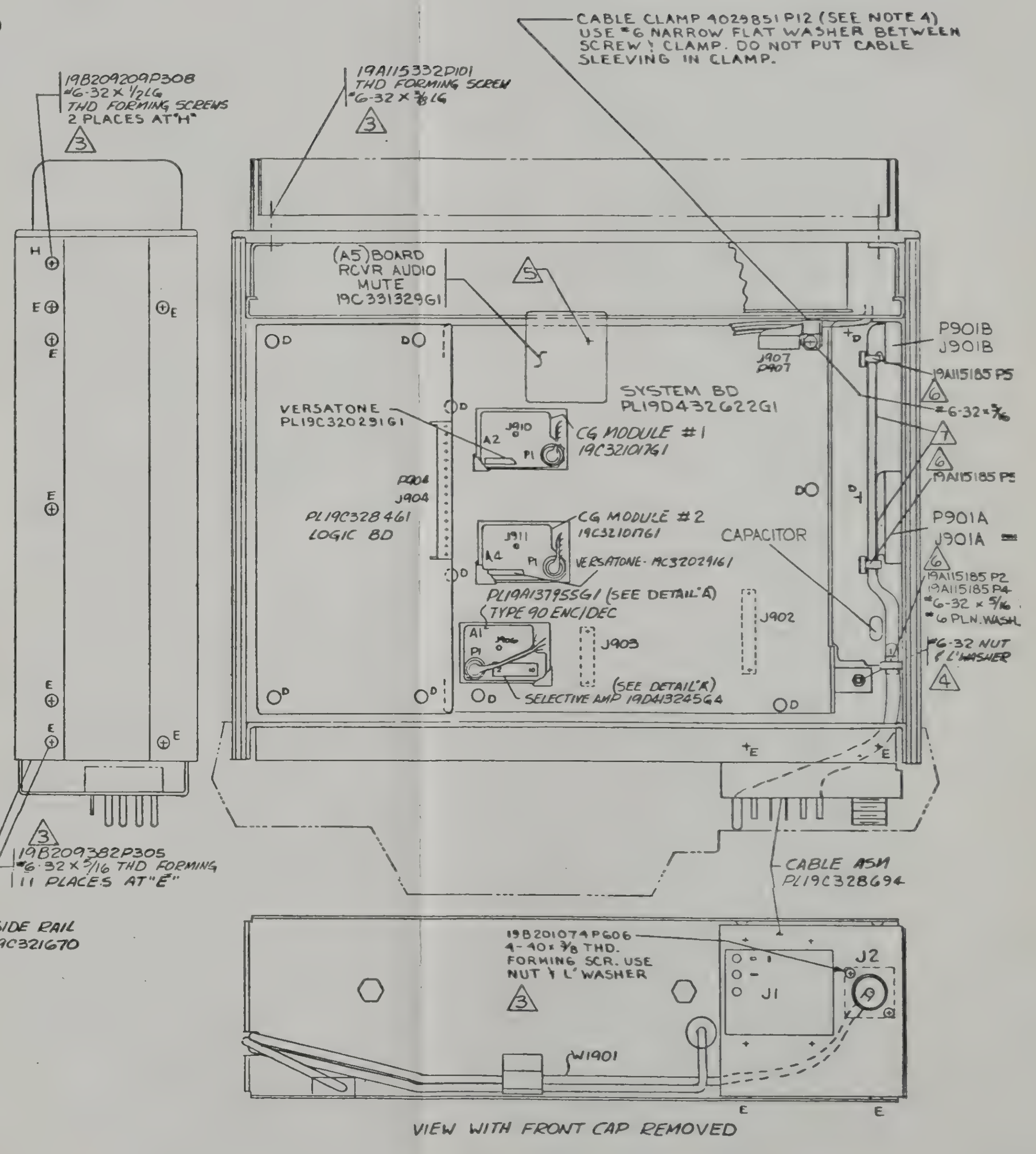

RF OUTPUT
XMIT FILTER
P3
P202
J202
TO RECEIVER J1
TO J2 (ANTENNA)

VIEW "B"


19B209209P306
#6-32 X 3/8 LG THD FORMING SCREW 2 PLACES AT TOP
3
H
H
CHASSIS ASM 19C328697
AMPL/ANT SWITCH 19D429881
XMIT FILTER
"F"
P101
J101
"B"
RECEIVE XTAL PL19B226962
RCVR OSC MULTIPLIER
EXCITER HB-19D423293
RECEIVER ASM FOR RECEIVER APPL ASM SEE 19D423490
COVER, BOTTOM 19C303911
COVER, TOP 19D402629
#6-32 X 1/4 LG RD HD SCREW 25 PLACES AT "D"
3
P602
J602
I F DETECTOR
TRANSMIT XTAL PL19B226962
P101
P903
P102
J1
TO RF OUTPUT
D
FRONT CAP ASM 19D423302G1
1
SELECTIVE AMP 19D413245G4
TYPE 90 ENC/DEC 19C317553
NP 280471 MARK PER 19A122529
NP280330 MARK & APPLY PER 19A122529

DETAIL "A" (SOLDER SIDE)

SOLDER SELECTIVE AMP TO TYPE 90 ENC/DEC BD AS SHOWN.

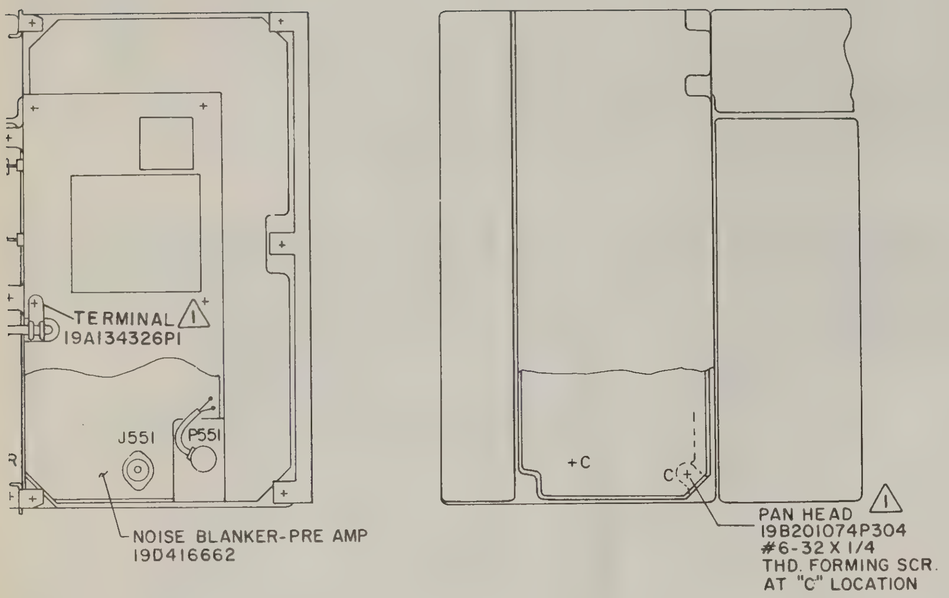

19B209209P308
#6-32 X 1/2 LG THD FORMING SCREWS 2 PLACES AT "H"
3
19A115332P101 THD FORMING SCREW #6-32 X 3/8 LG
3
CABLE CLAMP 4029851 P12 (SEE NOTE 4) USE #6 NARROW FLAT WASHER BETWEEN SCREW & CLAMP. DO NOT PUT CABLE SLEEVING IN CLAMP.
(A5) BOARD RCVR AUDIO MUTE 19C331329G1
5
H
E
D
J907
P907
SYSTEM BD PL19D432622G1
P901B
J901B
19A115185 P5
6
#6-32 x 5/16
7
6
19A115185 P5
VERSATONE PL19C320291G1
J910
A2
P1
CG MODULE #1 19C321017G1
P904
J904
PL19C328461 LOGIC BD
CG MODULE #2 19C321017G1
J911
A4
P1
VERSATONE- 19C320291G1
CAPACITOR
P901A
J901A
6
19A115185 P2
19A115185 P4
#6-32 x 5/16
#6 PLN. WASH.
#6-32 NUT & L'WASHER
4
PL19A137955G1 (SEE DETAIL "A")
TYPE 90 ENC/DEC
A1
P1
J903
J902
(SEE DETAIL "A")
SELECTIVE AMP 19D413245G4
3
19B209382P305
#6-32 X 5/16 THD FORMING 11 PLACES AT "E"
SIDE RAIL 19C321670
CABLE ASM PL19C328694
19B201074P606 4-40 x 3/8 THD. FORMING SCR. USE NUT & L' WASHER
3
J2
J1
W1901
E

VIEW WITH FRONT CAP REMOVED

(19D432882, Rev. 2)

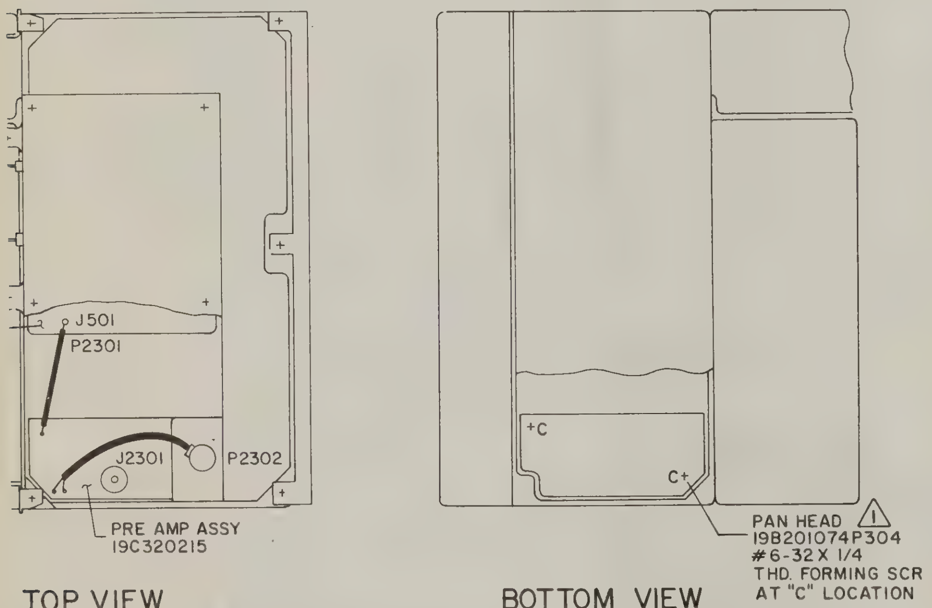
MECHANICAL PARTS BREAKDOWN

MAIN CHASSIS


TERMINAL 1
19A134326P1
J551
P551
+C
C+
PAN HEAD 1
19B201074P304
#6-32 X 1/4
THD. FORMING SCR.
AT "C" LOCATION
NOISE BLANKER-PRE AMP
19D416662

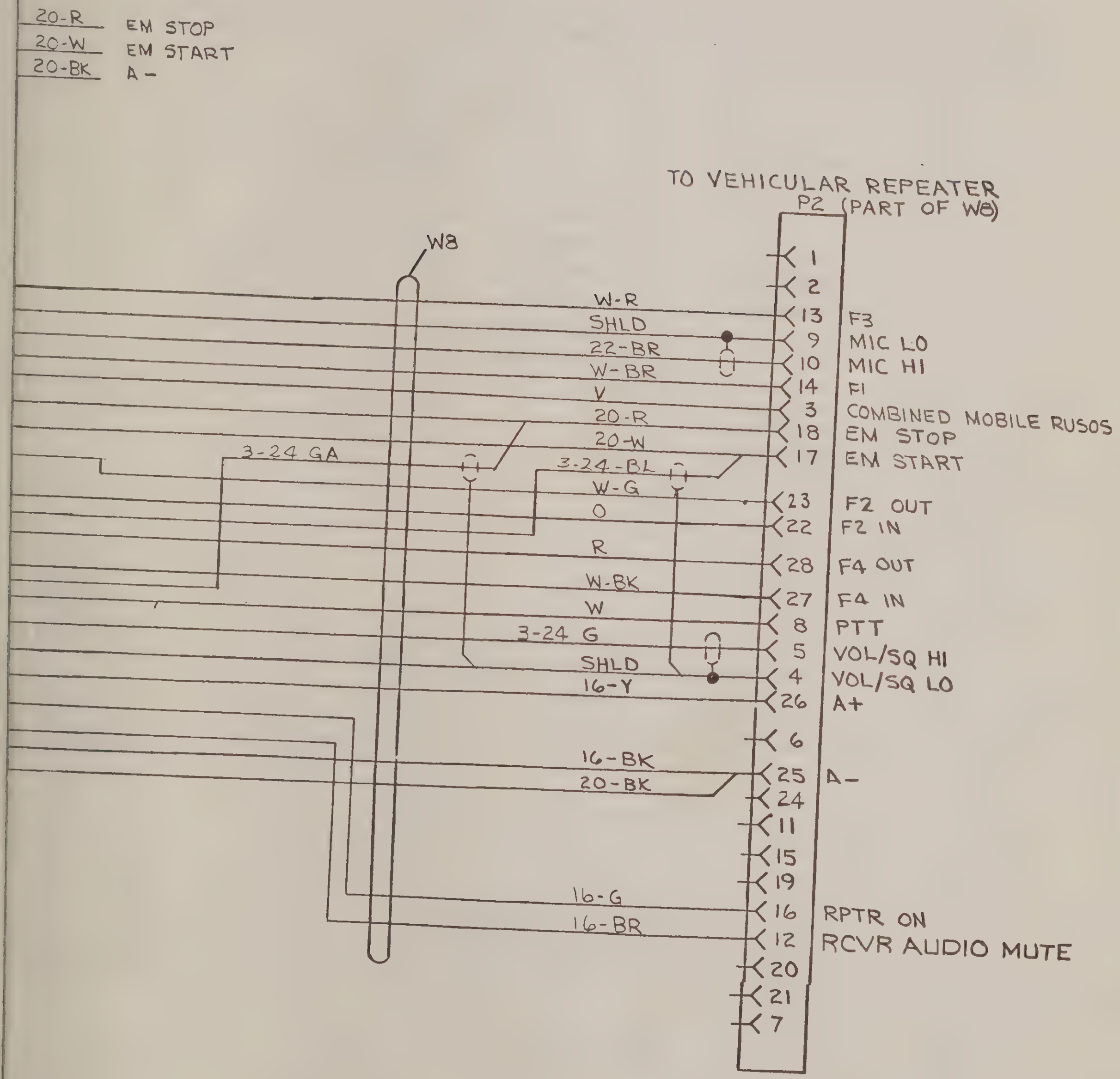
TOP VIEW BOTTOM VIEW

NOISE BLANKER-PRE AMP HIGH BAND


J501
P2301
J2301
P2302
+C
C+
PRE AMP ASSY
19C320215
PAN HEAD 1
19B201074P304
#6-32 X 1/4
THD. FORMING SCR
AT "C" LOCATION

TOP VIEW BOTTOM VIEW

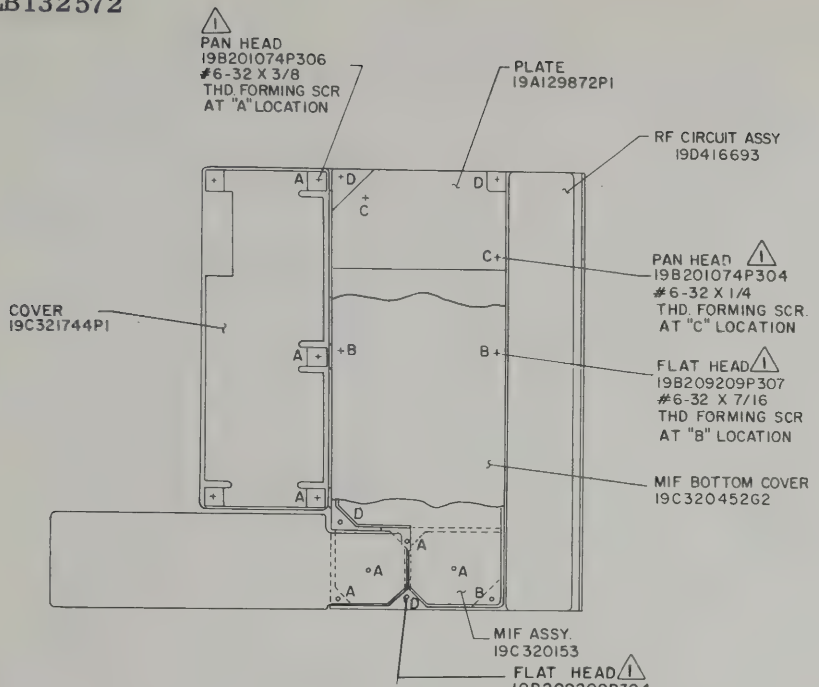
PRE-AMP HIGH BAND


20-R EM STOP
20-W EM START
20-BK A -
TO VEHICULAR REPEATER
P2 (PART OF W8)
W8
1
2
W-R
13 F3
SHLD
9 MIC LO
22-BR
10 MIC HI
W-BR
14 F1
V
3 COMBINED MOBILE RUSOS
20-R
18 EM STOP
20-W
17 EM START
3-24 GA
3-24-BL
W-G
23 F2 OUT
O
22 F2 IN
R
28 F4 OUT
W-BK
27 F4 IN
W
8 PTT
3-24 G
5 VOL/SQ HI
SHLD
4 VOL/SQ LO
16-Y
26 A+
6
16-BK
25 A-
20-BK
24
11
15
19
16-G
16 RPTR ON
16-BR
12 RCVR AUDIO MUTE
20
21
7

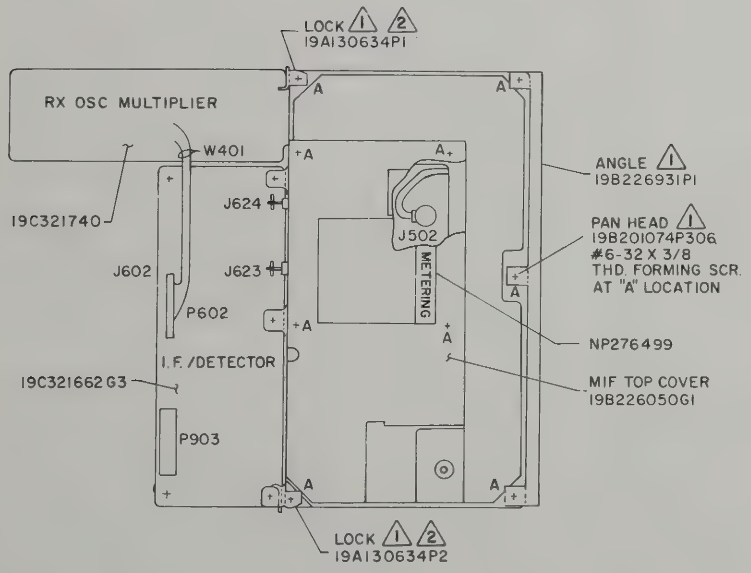
(19R622481, Rev. 3)

SCHEMATIC DIAGRAM

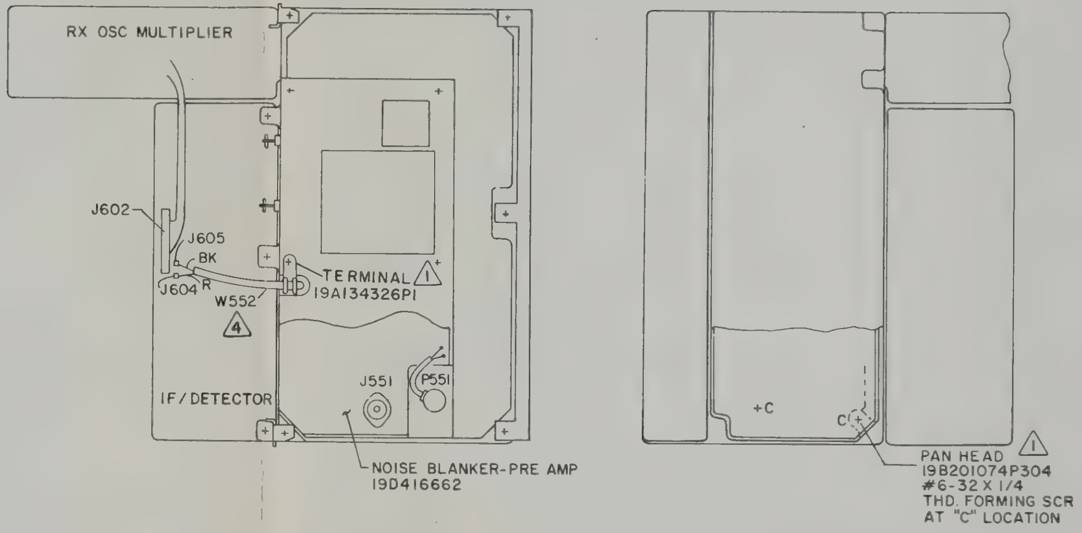
MICRO® INTERFACE CABLE


PAN HEAD
19B201074P306
#6-32 X 3/8
THD. FORMING SCR
AT "A" LOCATION
PLATE
19A129872P1
RF CIRCUIT ASSY
19D416693
COVER
19C321744P1
PAN HEAD
19B201074P304
#6-32 X 1/4
THD. FORMING SCR.
AT "C" LOCATION
FLAT HEAD
19B209209P307
#6-32 X 7/16
THD FORMING SCR
AT "B" LOCATION
MIF BOTTOM COVER
19C320452G2
MIF ASSY.
19C320153
FLAT HEAD
19B209209P304
#6-32 X 1/4
THD. FORMING SCR.
AT "D" LOCATION
A
B
C
D

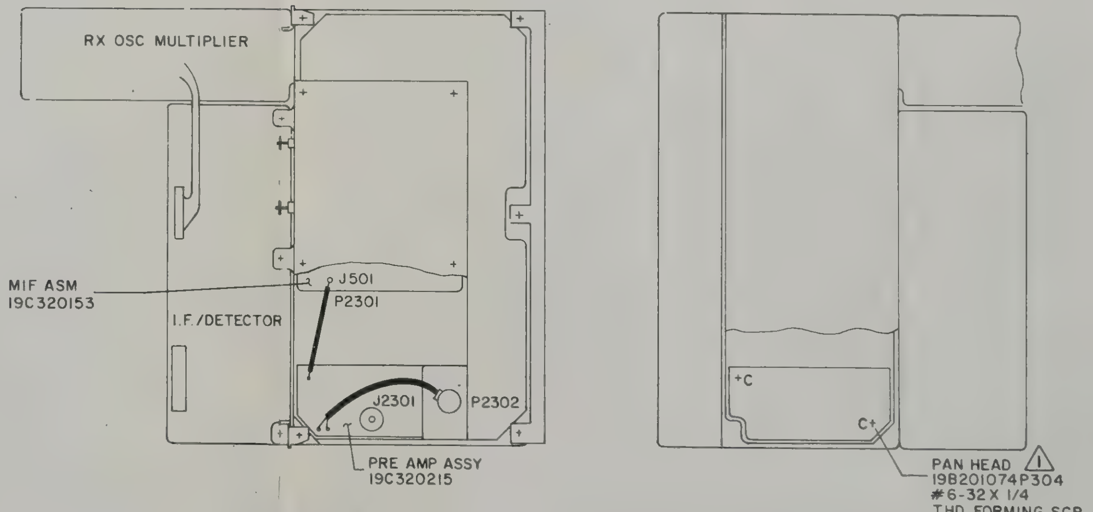
BOTTOM VIEW


LOCK
19A130634P1
RX OSC MULTIPLIER
W401
19C321740
J624
J623
J602
P602
J502
METERING
ANGLE
19B222693IP1
PAN HEAD
19B201074P306
#6-32 X 3/8
THD. FORMING SCR.
AT "A" LOCATION
NP276499
MIF TOP COVER
19B226050G1
I.F. /DETECTOR
19C321662 G3
P903
LOCK
19A130634P2
A

RECEIVER HIGH BAND
TOP VIEW


RX OSC MULTIPLIER
J602
J605
BK
J604
R
W552
TERMINAL
19A134326P1
IF/DETECTOR
J551
P551
NOISE BLANKER-PRE AMP
19D416662
C
PAN HEAD
19B201074P304
#6-32 X 1/4
THD. FORMING SCR
AT "C" LOCATION

TOP VIEW BOTTOM VIEW
NOISE BLANKER-PRE AMP HIGH BAND

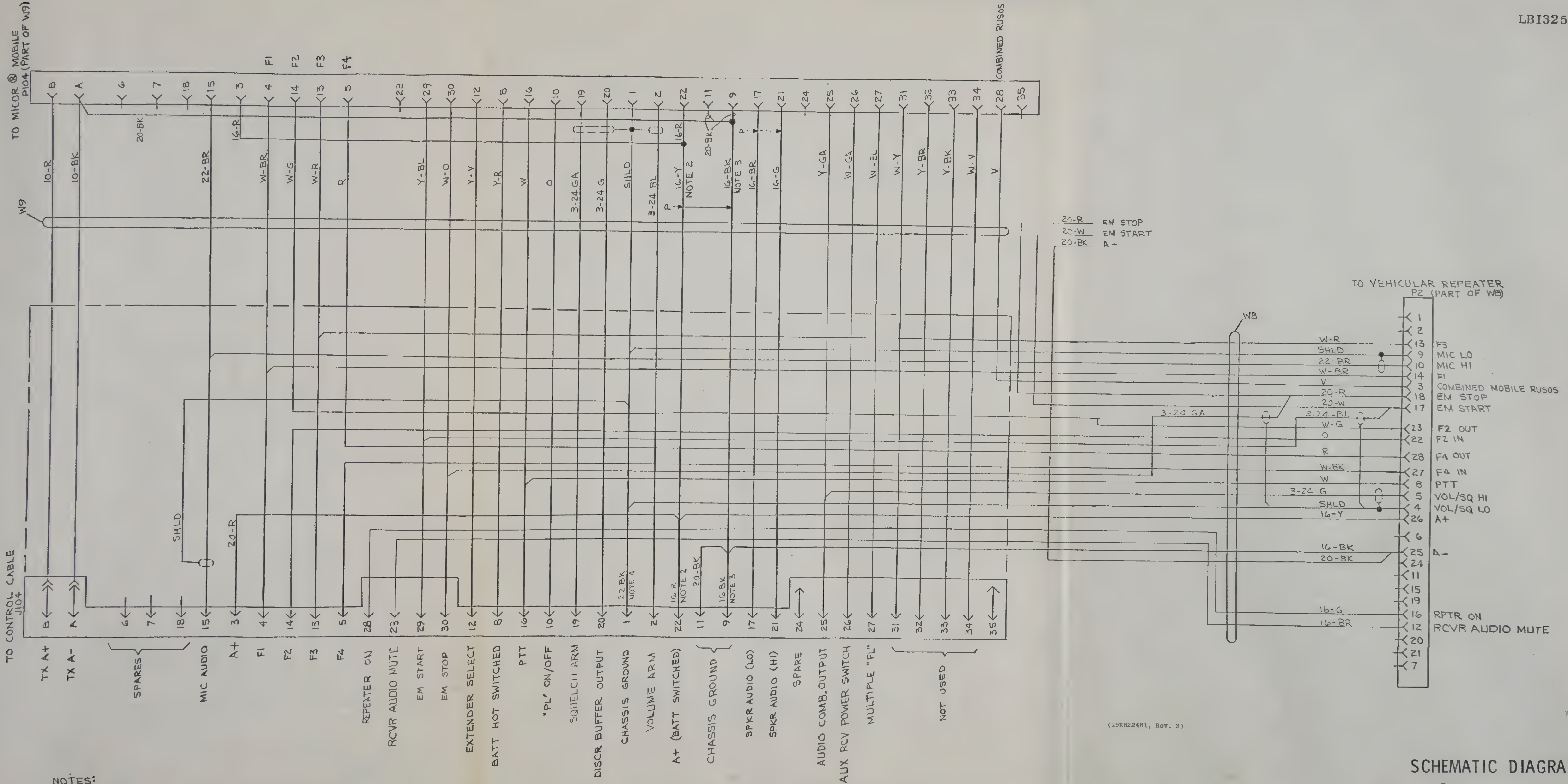

RX OSC MULTIPLIER
MIF ASM
19C320153
J501
P2301
I.F. /DETECTOR
J2301
P2302
PRE AMP ASSY
19C320215
C
PAN HEAD
19B201074P304
#6-32 X 1/4
THD. FORMING SCR
AT "C" LOCATION

TOP VIEW BOTTOM VIEW
PRE-AMP HIGH BAND

MECHANICAL PARTS BREAKDOWN

138--174 MHz RECEIVER ASSEMBLY

(19D423490, Sh. 2, Rev. 4)


TO MICOR ® MOBILE P104 (PART OF W9)
COMBINED RUSOS
F1
F2
F3
F4
W9
W8
20-R EM STOP
20-W EM START
20-BK A-
TO VEHICULAR REPEATER P2 (PART OF W8)
F3
MIC LO
MIC HI
F1
COMBINED MOBILE RUSOS
EM STOP
EM START
F2 OUT
F2 IN
F4 OUT
F4 IN
PTT
VOL/SQ HI
VOL/SQ LO
A+
A-
RPTR ON
RCVR AUDIO MUTE
TO CONTROL CABLE J104
TX A+
TX A-
SPARES
MIC AUDIO
A+
F1
F2
F3
F4
REPEATER ON
RCVR AUDIO MUTE
EM START
EM STOP
EXTENDER SELECT
BATT HOT SWITCHED
PTT
"PL" ON/OFF
SQUELCH ARM
DISCR BUFFER OUTPUT
CHASSIS GROUND
VOLUME ARM
A+ (BATT SWITCHED)
CHASSIS GROUND
SPKR AUDIO (LO)
SPKR AUDIO (HI)
SPARE
AUDIO COMB. OUTPUT
AUX RCV POWER SWITCH
MULTIPLE "PL"
NOT USED
22 BK NOTE 4
16 R NOTE 2
16 BK NOTE 3
16-Y NOTE 2
16-BK NOTE 3

(19R622481, Rev. 3)

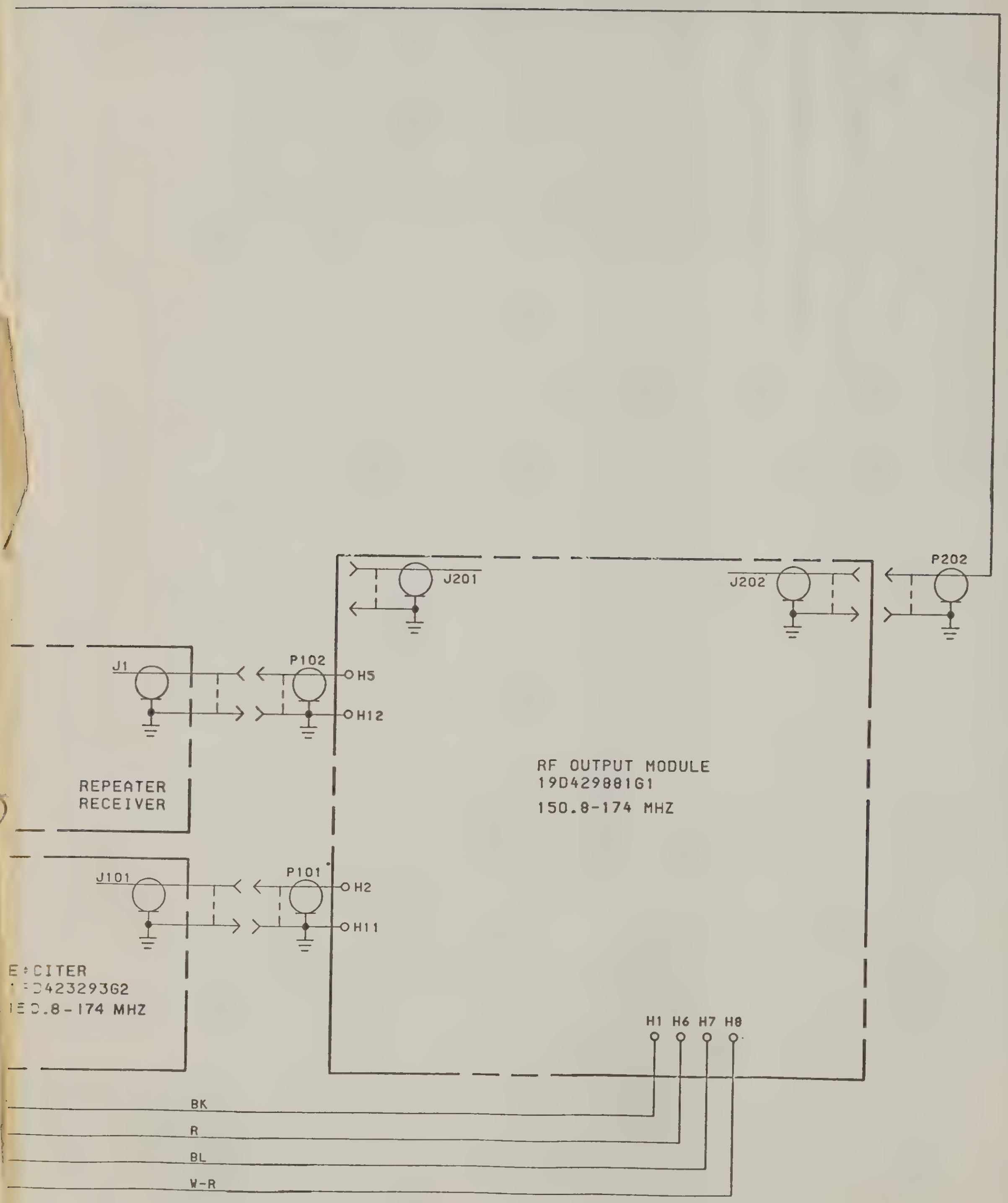
NOTES:

1. ALL WIRES SF24 UNLESS NOTED OTHERWISE.
2. Y AND R WIRES JOINED WITH SPLICE NUT.
3. BK WIRES JOINED WITH SPLICE NUT.
4. SHIELDS & 22 BK JOINED WITH SPLICE NUT

SCHEMATIC DIAGRAM

MICRO® INTERFACE CABLE

Issue 2


P202
J201
J202
J1
P102
H5
H12
RF OUTPUT MODULE
19D429881G1
150.8-174 MHZ
REPEATER
RECEIVER
J101
P101
H2
H11
EXCITER
19D423293G2
150.8-174 MHZ
H1
H6
H7
H8
BK
R
BL
W-R

PTION

RECEPTACLES - - - - - - -

F206-2460).
352-4101-A16B. (J104-A &

, 8 thru 17, 19 thru 23,

BLES - - - - - - - - -

SEMBLY
86G5

UGS - - - - - - - - - -

x 1-1/4. (Secures covers)

(Secures covers).

SEMBLY
90G4

UGS - - - - - - - - - -

ence Req. F206-2460).
59-2001-A16B.

, 8 thru 17, 19 thru 22,

DRIV®: No. 7-19 x 1/2.
er to housing).

DRIV®: No. 8-18 x 3/4.
er to housing).

LANEOUS - - - - - - - -

J104).

04).

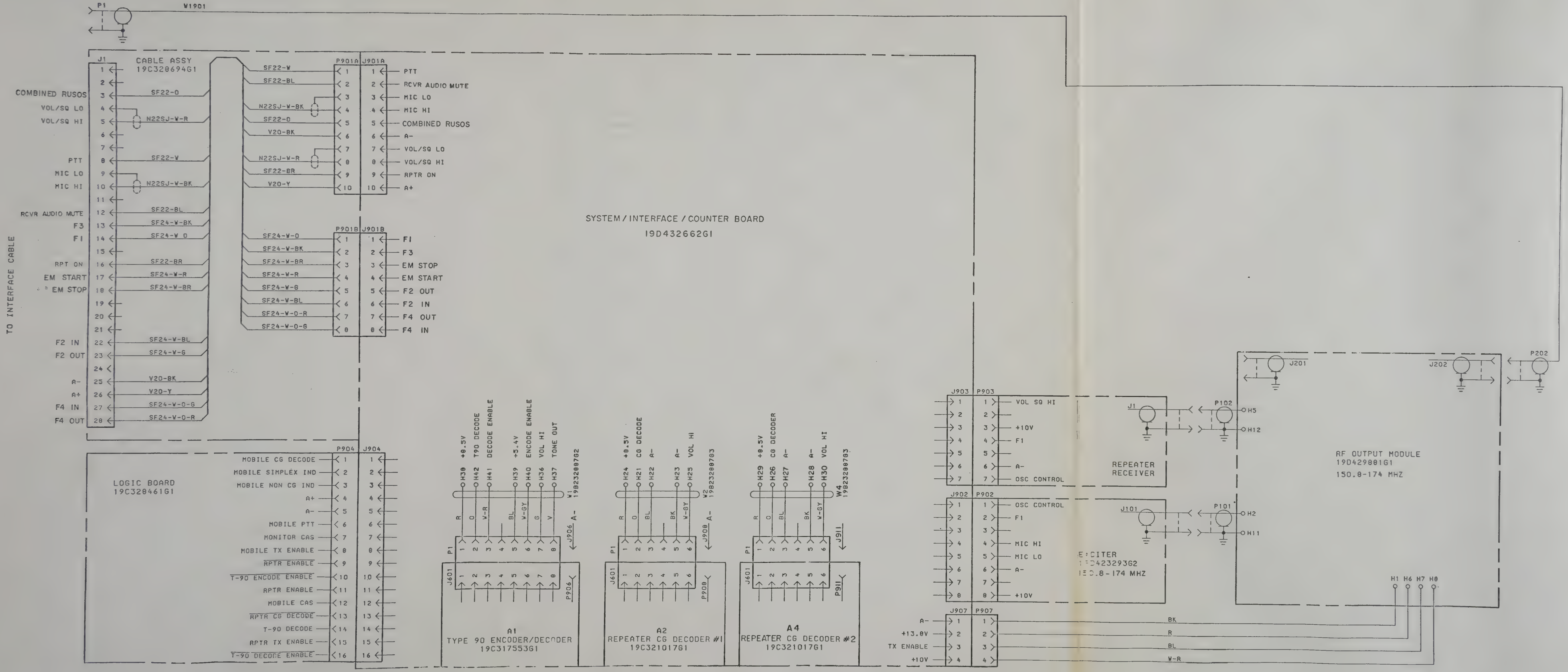
DRIV®: No. 6-32 x 1/4.

- Reference Req. F206-

Dennison Bar-Lok 08470.

9 in housing).

PRODUCTION CHANGES


P1
W1901
J1
CABLE ASSY
19C328694G1
TO INTERFACE CABLE
COMBINED RUSOS
VOL/SQ LO
VOL/SQ HI
PTT
MIC LO
MIC HI
RCVR AUDIO MUTE
F3
F1
RPT ON
EM START
EM STOP
F2 IN
F2 OUT
A-
A+
F4 IN
F4 OUT
SF22-O
N22SJ-W-R
SF22-V
N22SJ-W-BK
SF22-BL
SF24-W-BK
SF24-W-O
SF22-BR
SF24-W-R
SF24-W-BR
SF24-W-BL
SF24-W-G
V20-BK
V20-Y
SF24-W-O-G
SF24-W-O-R
P901A
J901A
SF22-W
SF22-BL
N22SJ-W-BK
SF22-O
V20-BK
N22SJ-W-R
SF22-BR
V20-Y
PTT
RCVR AUDIO MUTE
MIC LO
MIC HI
COMBINED RUSOS
A-
VOL/SQ LO
VOL/SQ HI
RPTR ON
A+
P901B
J901B
SF24-W-O
SF24-W-BK
SF24-W-BR
SF24-W-R
SF24-W-G
SF24-W-BL
SF24-W-O-R
SF24-W-O-G
F1
F3
EM STOP
EM START
F2 OUT
F2 IN
F4 OUT
F4 IN
SYSTEM / INTERFACE / COUNTER BOARD
19D432662G1
LOGIC BOARD
19C328461G1
P904
J904
MOBILE CG DECODE
MOBILE SIMPLEX IND
MOBILE NON CG IND
A+
A-
MOBILE PTT
MONITOR CAS
MOBILE TX ENABLE
RPTR ENABLE
T-90 ENCODE ENABLE
RPTR ENABLE
MOBILE CAS
RPTR CG DECODE
T-90 DECODE
RPTR TX ENABLE
T-90 DECODE ENABLE
+8.5V
T90 DECODE
DECODE ENABLE
+5.4V
ENCODE ENABLE
VOL HI
TONE OUT
H38 H42 H41 H39 H40 H36 H37
W1
19B232807G2
R O V-R BL W-GY G V
J906 A-
P1
J601
P906
A1
TYPE 90 ENCODER/DECODER
19C317553G1
+8.5V
CG DECODE
A-
A-
VOL HI
H24 H21 H22 H23 H25
W2
19B232807G3
R O BL BK W-GY
J908 A-
P908
A2
REPEATER CG DECODER #1
19C321017G1
+8.5V
CG DECODER
A-
A-
VOL HI
H29 H26 H27 H28 H30
W4
19B232807G3
R O BL BK W-GY
J911
P911
A4
REPEATER CG DECODER #2
19C321017G1
J903
P903
VOL SQ HI
+10V
F1
A-
OSC CONTROL
REPEATER RECEIVER
J1
P102
H5
H12
J902
P902
OSC CONTROL
F1
MIC HI
MIC LO
A-
+10V
EXCITER
19D423293G2
150.8-174 MHZ
J101
P101
H2
H11
J907
P907
A-
+13.8V
TX ENABLE
+10V
BK
R
BL
W-R
J201
J202
P202
RF OUTPUT MODULE
19D429881G1
150.8-174 MHZ
H1 H6 H7 H8

(19R601676, Rev. 1)

INTERCONNECTION DIAGRAM

VEHICULAR REPEATER INTERFACE

PARTS LIST

FRONT CAP ASSEMBLY
19D423302G1
ISSUE 1

SYMBOL	GE PART NO.	DESCRIPTION
	19D423283P1	Front cap.
	19D423284P1	Handle.
	5491682P21	Rim lock: sim to Yale & Towne Cylinder 9899.
	19A130614G1	Latch. (Used with 5491682P21 rim lock).
	19A134222P1	Washer, spring tension. (Used to secure rim lock).
	19A122242P1	Shoulder screw, black: No. 8-32 x 1. (Secures handle to cap & cap to chassis).
	19A116772P1	Lockwasher, tooth: sim to Shakeproof 4708-06-02. (Secures handle to cap & cap to chassis).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

PARTS LIST

CHASSIS ASSEMBLY
19C320607G1
ISSUE 1

SYMBOL	GE PART NO.	DESCRIPTION
W1001		CABLE ASSEMBLY 19B227513G1
		- - - - - - - - - - - PLUGS - - - - - - - - - - -
P1		Connector. Includes:
	4029493P1	Connector, receptacle: sim to Amphenol 83-798.
	4029032P2	Cover.
P202	5491689P121	Connector. (Includes 2 feet cable).
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19C328644G1	Frame.
	19C321670G2	Rail.
	19A134313P1	Spacer, threaded.
	4029030P12	Seal, rubber channel.
	19A116552P3	Cable clip: sim to Richco KKC-4.
	N405P13C6	Lockwasher, internal tooth: No. 8. (Located under threaded spacer).
	19B209332P305	Tap screw, Phillips Pozidriv®: No. 6-32 x 5/16. (Secures rail).
	19B209382P304	Tap screw, Phillips Pozidriv®: No. 6-32 x 1/4. (Quantity 2- Located in side rail).

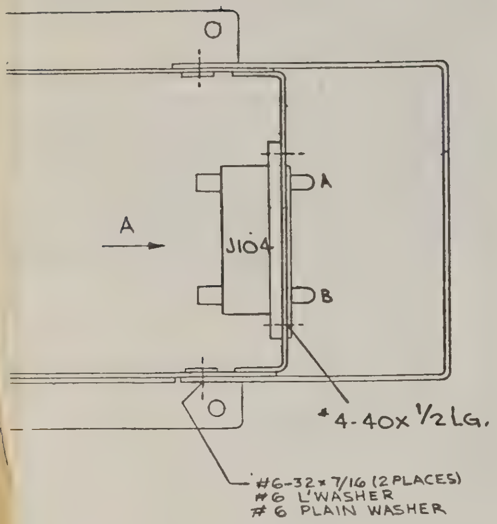
PARTS LIST

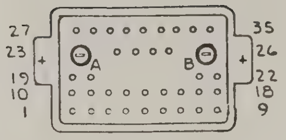
INTERFACE CABLE
19D430785G5

ISSUE 2

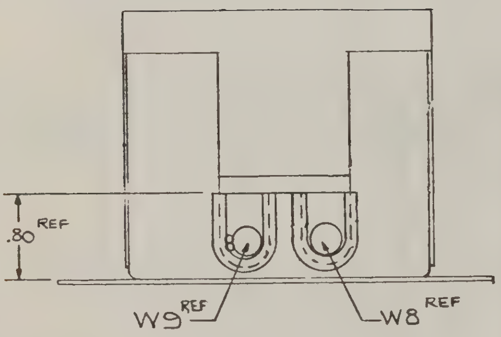
SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - JACKS AND RECEPTACLES - - - - - - -
J104		Connector. Includes:
	HS800918-1	Shell. (Reference Req. F206-2460). Contact. VERNATRON P3-3352-4101-A16B. (J104-A & J104-B).
	19A144001G2	Contact. (J104-1 thru 5, 8 thru 17, 19 thru 23, 25 thru 34).
		- - - - - - - - - - - CABLES - - - - - - - - -
W8		CABLE ASSEMBLY 19D430786G5
		- - - - - - - - - - - PLUGS - - - - - - - - - -
P2		Connector. Includes:
	19C311409P1	Connector.
	19D413039P1	Cover. (Nut side).
	19D413039P2	Cover. (Screw side).
	19C311411G1	Thumbscrew.
	N36P9020C6	Machine screw: No. 4-40 x 1-1/4. (Secures covers).
	N210P9C6	Nut, steel: No. 4-40. (Secures covers).
W9		CABLE ASSEMBLY 19C330490G4
		- - - - - - - - - - - PLUGS - - - - - - - - - -
P104		Connector. Includes:
	HS800918-2	Connector block. (Reference Req. F206-2460). Contact. VERNATRON S-3359-2001-A16B. (P104-A & P104-B).
	19A144001G1	Contact. (P104-1 thru 5, 8 thru 17, 19 thru 22, 25 thru 34).
	19A143956G1	Housing.
	19B233877P1	Cover.
	19A116773P108	Tap screw, Phillips POZIDRIV®: No. 7-19 x 1/2. (Quantity 2- Secures cover to housing).
	19A116773P212	Tap screw, Phillips POZIDRIV®: No. 8-18 x 3/4. (Quantity 1- Secures cover to housing).
		- - - - - - - - - MISCELLANEOUS - - - - - - - -
	19C331171G1	Box. (Contains J104).
	19A142959P1	U Support. (Located at J104).
	19B233459P3	Cover. (Located over J104).
	19B201074P304	Tap screw, Phillips POZIDRIV®: No. 6-32 x 1/4. (Secures J104 cover).
	HS801104-1	Plate. (Used with J104- Reference Req. F206-2460).
	5491480P6	Clamp. (Used with W8).
	5491480P8	Clamp. (Used with W9).
	19A115185P8	Retainer strap; sim to Dennison Bar-Lok 08470. (Used with W8 & W9).
	5491480P9	Cable loop. (Secures W9 in housing).
	19A115370P1	Splice nut.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES


A
J104
A
B
*4-40x ½ LG.
#6-32 × 7/16 (2 PLACES)
#6 L'WASHER
#6 PLAIN WASHER


27
23
19
10
1
35
26
22
18
9
A
B
+
+

VIEW A OF J104
ROTATED 90°
COUNTER CLOCKWISE


.80 REF
W9 REF
W8 REF

VIEW-B
ROTATED 90° C'CLOCKWISE

LBI30115B
DF9040I

INSTALLATION MANUAL FOR

MASTR *Executive II* MOBILE COMBINATIONS

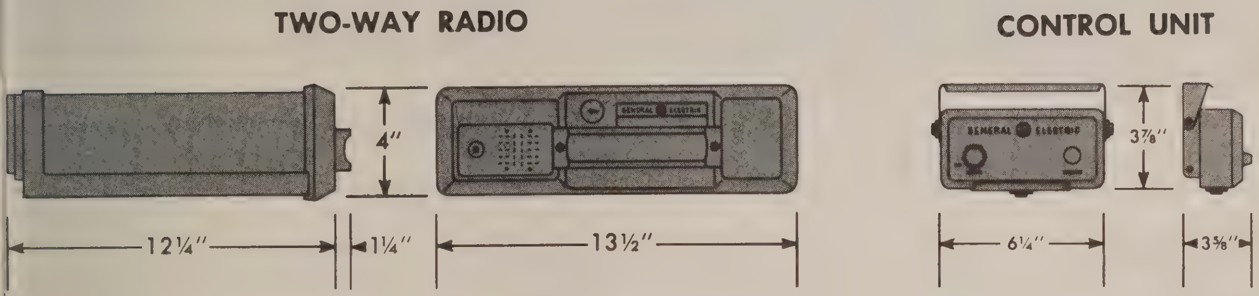


Figure 1 — Mounting Dimensions

INSTALLATION EQUIPMENT

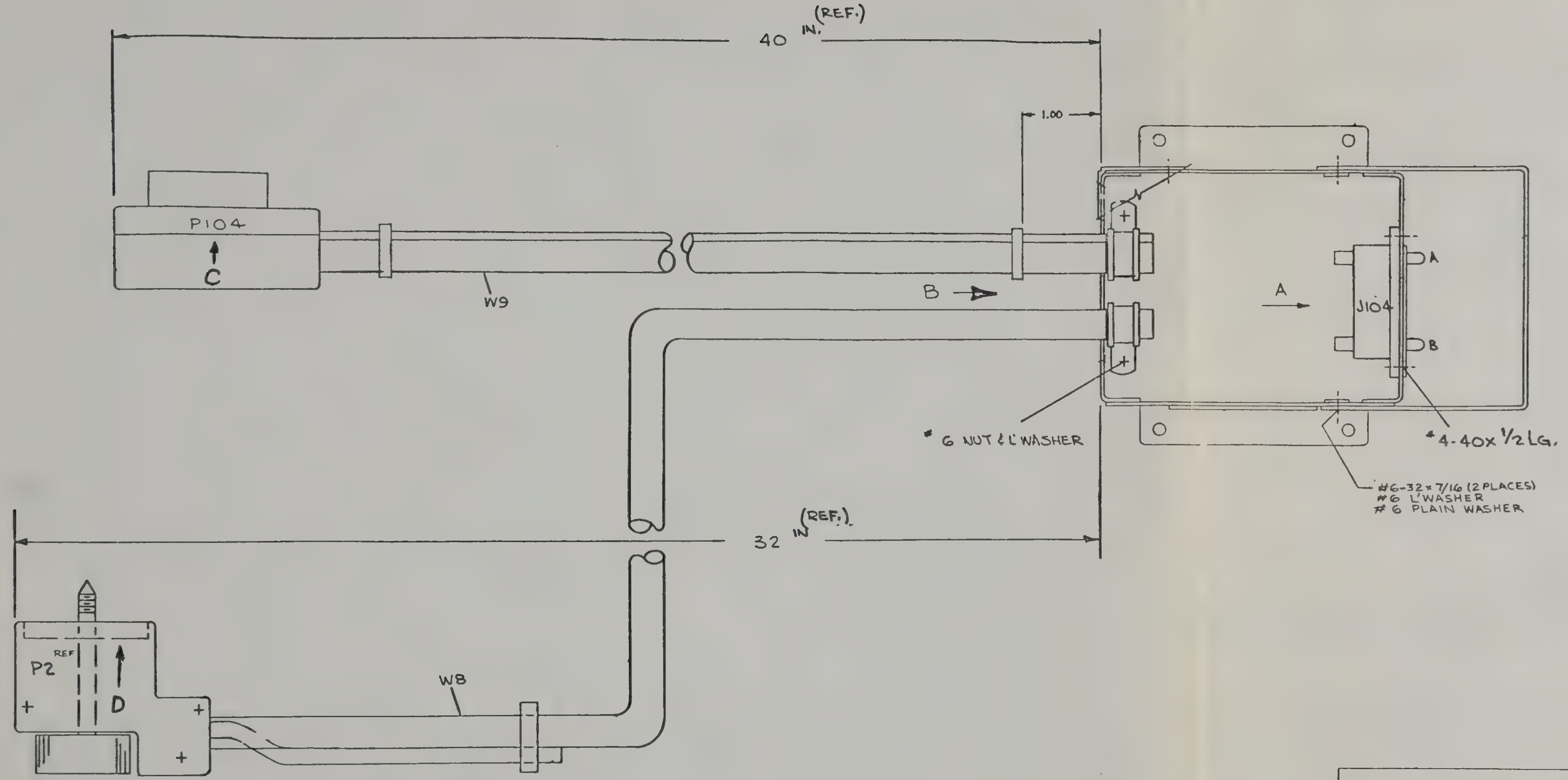
The equipment required for installing the Two-Way Radio includes:

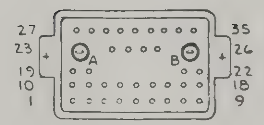
- An electric drill for drilling mounting holes
- Drills and circle cutters (see sizes in box below)
- A soldering iron for the antenna cable
- Phillips and flat-blade screwdrivers and a 5/16-inch hex head driver for mounting screws.

DRILL SIZES

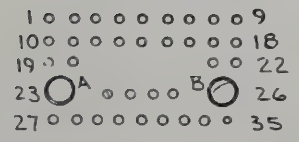
No. 31 (1/8-inch) Drill for No. 8 Self-Tapping Screws
No. 27 (9/64-inch) Drill for No. 10 Self-Tapping Screws
9/32-Inch Drill for Lo-Band Antenna and 1/4-inch Bolt
3/4-Inch Punch or Holesaw for High Band/UHF Antenna
1-3/8-Inch Circle Cutter, Holesaw and Socket Punch for Lo-Band Antenna
1-1/8-Inch Circle Cutter, Holesaw and Socket Punch for rubber grommet.

GENERAL ELECTRIC


40 IN. (REF.)
1.00
P104
C
W9
B
A
J104
A
B
# 6 NUT & L' WASHER
# 4-40 x 1/2 LG.
#6-32 x 7/16 (2 PLACES)
#6 L' WASHER
#6 PLAIN WASHER
32 IN (REF.)
P2 REF
D
W8
+

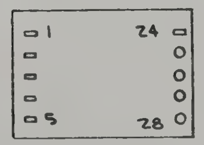

27
23
19
10
1
35
26
22
18
9
A
B

VIEW A OF J104
ROTATED 90°
COUNTER CLOCKWISE

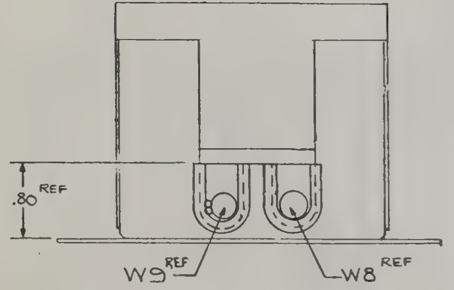

1
9
10
18
19
22
23
A
B
26
27
35

CONNECTOR PIN NO.

VIEW 'C'



VIEW 'D'


.80 REF
W9 REF
W8 REF

VIEW B
ROTATED 90° C'CLOCKWISE

(19D430785, Sh. 6, Rev. 3)

OUTLINE DIAGRAM

INTERFACE BOARD

LBI30115B
DF9040)

INSTALLATION MANUAL FOR

MASTR *Executive II*
MOBILE COMBINATIONS

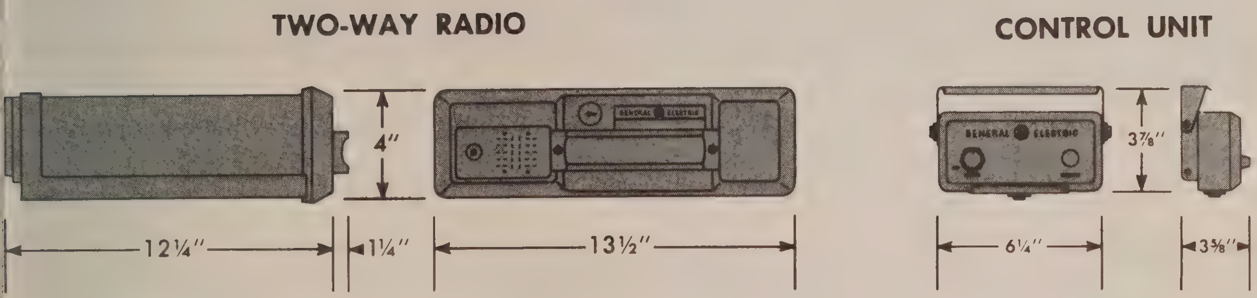


Figure 1 – Mounting Dimensions

INSTALLATION EQUIPMENT

The equipment required for installing the Two-Way Radio includes:

- An electric drill for drilling mounting holes
- Drills and circle cutters (see sizes in box below)
- A soldering iron for the antenna cable
- Phillips and flat-blade screwdrivers and a 5/16-inch hex head driver for mounting screws.

DRILL SIZES

No. 31 (1/8-inch) Drill for No. 8 Self-Tapping Screws
No. 27 (9/64-inch) Drill for No. 10 Self-Tapping Screws
9/32-Inch Drill for Lo-Band Antenna and 1/4-inch Bolt
3/4-Inch Punch or Holesaw for High Band/UHF Antenna
1-3/8-Inch Circle Cutter, Holesaw and Socket Punch for Lo-Band Antenna
1-1/8-Inch Circle Cutter, Holesaw and Socket Punch for rubber grommet.

GENERAL ELECTRIC

UNPACKING AND CHECKING EQUIPMENT

Carefully unpack the Two-Way Radio. It is recommended that you identify the items in the packing case and check them off in the appropriate column below before discarding the packing material. If any damage has occurred to the equipment during shipment, file a claim with the carrier immediately.

EQUIPMENT

Two-Way Radio . . . . ☐

Control Unit . . . . ☐

Speaker . . . . ☐

Microphone . . . . ☐

Microphone Bracket . . . . ☐

Antenna Cable and RF Connector . . . . ☐
(25-88 MHz antenna whip shipped
in separate carton)

Top Cover 19D402629P2 . . . . ☐

Bottom Cover 19C303911G4 (Standard) . . . . . . ☐

Bottom Cover 19C303911G6 (Hi Power) . . . . . . ☐

Mounting Hardware 19A122244G6 . . . . ☐

Fuse Assembly (12-Volt) . . . . ☐
- High Power (30 Amp Fuse)
  (66 to 110 Watts)
  19B216021G3
- Medium Power (20 Amp Fuse)
  (35 to 65 Watts)
  19B216021G6
- Low Power (15 Amp Fuse)
  (to 35 Watts)
  19B216021G1

Power/Control Cable . . . . ☐
19C303910-G1 – G4

Alignment Tools (2) . . . . ☐

Key 5491682-P8 . . . . ☐

OPTIONAL EQUIPMENT

	OPTION NUMBER
Window Mounting Kit	1706
Handset Model 19B209100P3 with . . . . Hookswitch 19B204867-G4	1703
Weatherproof Box	1710
Internal/External Speaker	1707

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PLANNING THE INSTALLATION

efore starting, plan your installation carefully—o that it will be:

- Convenient for the operator to use
- Neat —
- Protected from damage from water
- Easy for the serviceman to service
- Out of the way of auto mechanics
- Out of the way of passengers

It is suggested that you take advantage of the experience of one of the many authorized General Electric Service Stations located throughout the United States by having them install your Two-Way Radio and make the final adjustments.

WARNING

Interference with Vehicular Electronics — *Electronic fuel injection systems, electronic anti-skid braking systems, electronic cruise control systems, etc., are typical of the types of electronic devices which may be prone to malfunction due to the lack of protection from radio frequency energy present when transmitting. If the vehicle contains such equipment, consult the dealer for the make of vehicle and enlist his aid in determining if such electronic circuits will perform normally when the radio is transmitting.*

RUNNING CABLES

To assure the feasibility of the cable routings you plan to use, the cables should be run prior to installing the unit. Try to route the cables away from locations where they may be damaged by heat (exhaust systems, etc.) or where they may be in the way of automobile mechanics, the driver or passengers. Whenever possible, utilize existing holes in the firewall and trunk and the channels above or beneath the doors. If an existing hole is not conveniently located for the passage of the power cable, drill a 1-1/8-inch hole and insert rubber grommet. Be sure to leave enough slack in the cables to allow the radio to be pulled out, with power applied, for servicing. Refer to the Cable Routing diagram (Fig. 2) and the Cabling Diagram, (Fig. 3) for additional information.

Starting with the plug end of the Power/Control cable at the location of the trunk mount unit, run the black control cable to the Control Unit location. Tape the numbered leads before running the cable.

Run the red battery lead to the vicinity of the battery. Cut the red lead and connect the fuse assembly in the red lead with ring terminals and lockwashers provided. Assemble one lockwasher between each terminal and one under the head of each screw. Then mount the fuse assembly near the battery, and connect the red lead to the positive (+) battery terminal. Next, connect the brown lead to a good vehicle ground in the trunk compartment.

Refer to Figure 8 for Ignition Switch Cable connections.

Figure 2 — Cable Routing

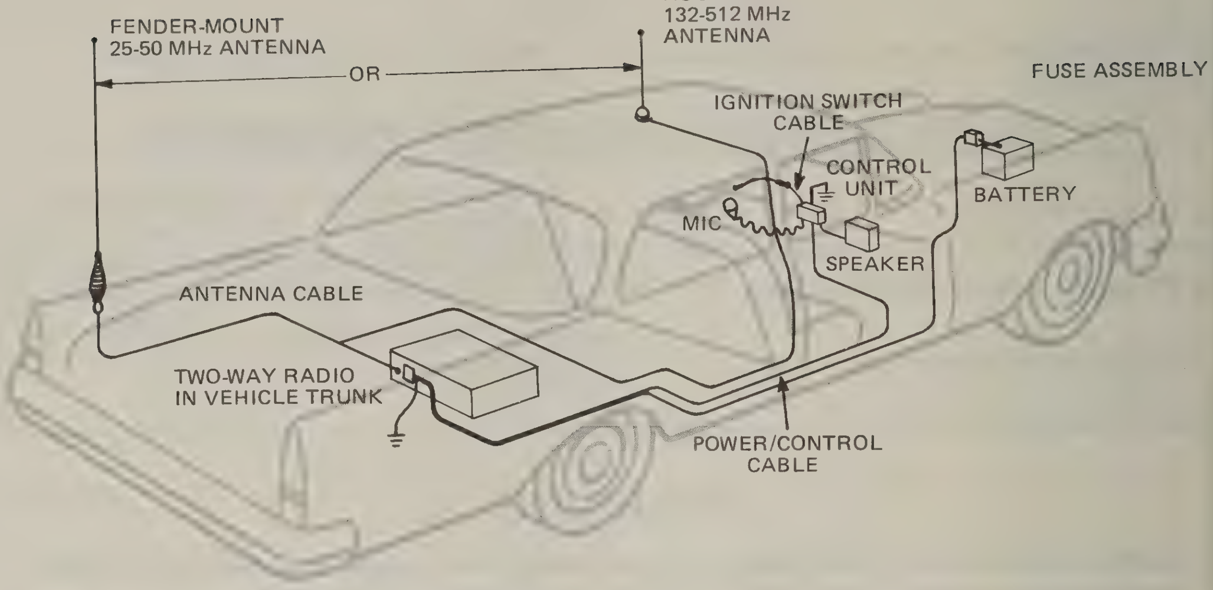
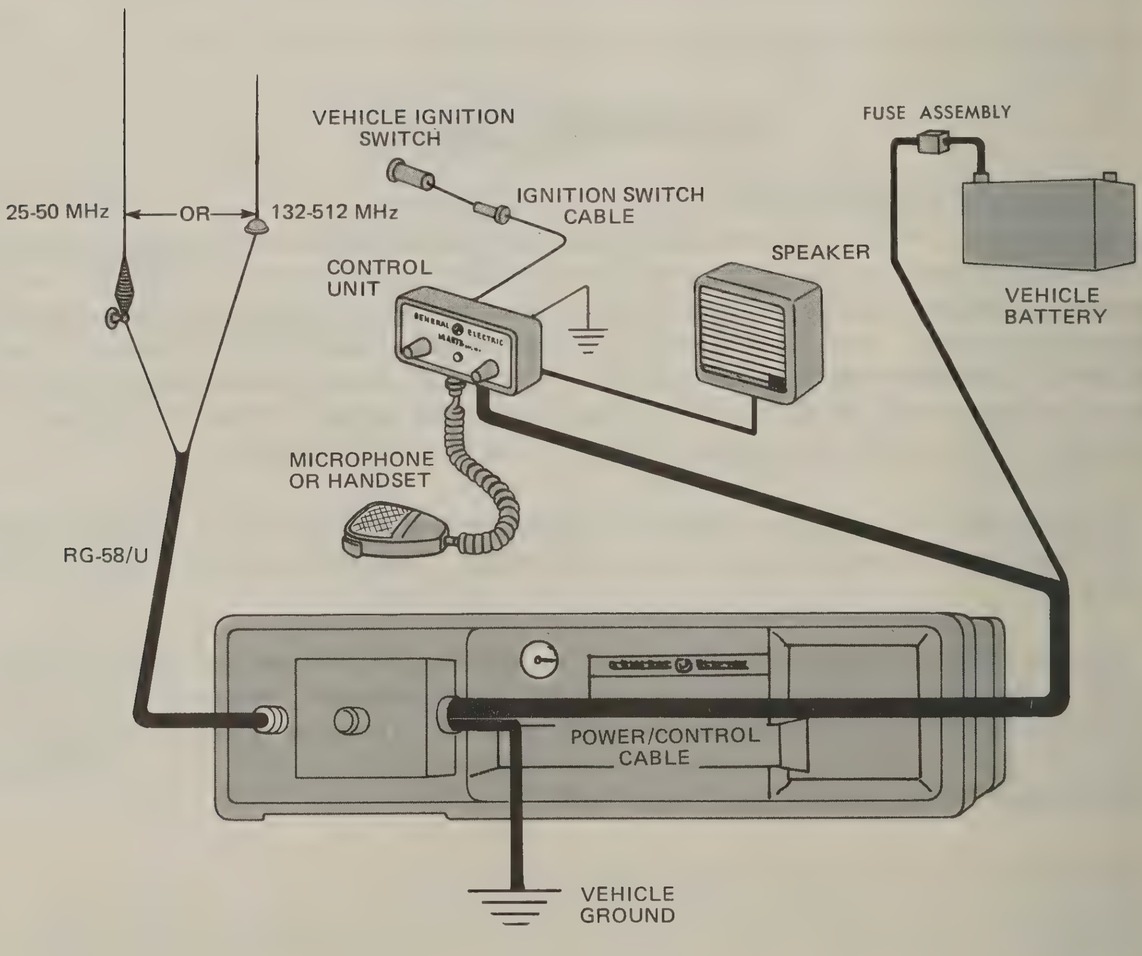

FENDER-MOUNT
25-50 MHz ANTENNA
OR
ROOF-MOUNT
132-512 MHz
ANTENNA
FUSE ASSEMBLY
IGNITION SWITCH
CABLE
CONTROL
UNIT
BATTERY
MIC
SPEAKER
ANTENNA CABLE
TWO-WAY RADIO
IN VEHICLE TRUNK
POWER/CONTROL
CABLE

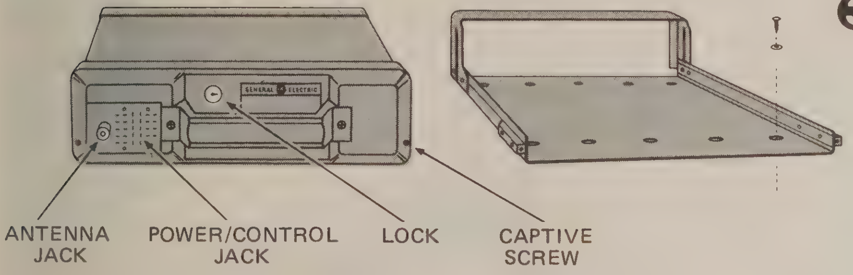
Figure 3 — Cabling Diagram


VEHICLE IGNITION
SWITCH
FUSE ASSEMBLY
25-50 MHz
OR
132-512 MHz
IGNITION SWITCH
CABLE
CONTROL
UNIT
SPEAKER
VEHICLE
BATTERY
GENERAL ELECTRIC
MICROPHONE
OR HANDSET
RG-58/U
POWER/CONTROL
CABLE
VEHICLE
GROUND

INSTALLING THE TWO-WAY RADIO

The Two-Way Radio may be mounted horizontally, vertically or on its side. Select a mounting location with sufficient room for the radio to be pulled out of the mounting frame for servicing. Mount the radio as shown in Figure 4.

Figure 4 — Installing the Two-Way Radio



① TO REMOVE RADIO FROM MOUNTING FRAME:
1. UNLOCK THE RADIO
2. LOOSEN THE TWO CAPTIVE SCREWS
3. PULL RADIO FORWARD OUT OF FRAME

② DRILL NO. 29 (9/64-INCH) PILOT HOLES

③ MOUNT FRAME WITH NO. 10x5/8-INCH SHEET METAL SCREWS AND LOCKWASHERS

④ REPLACE RADIO IN MOUNTING FRAME, TIGHTEN CAPTIVE SCREWS AND RELOCK. THEN CONNECT POWER/CONTROL AND ANTENNA CABLES.

CAUTION

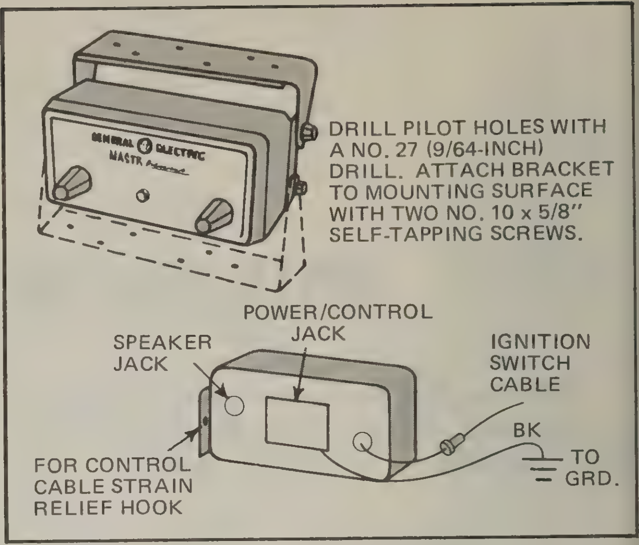
Be careful to avoid damaging some vital part of the vehicle when drilling mounting holes. Always check to see how far the mounting screws will extend below the mounting surface before installing.

WARNING

For passenger safety, mount the radio securely so that the unit will not break loose in the event of a collision. This is especially important in station wagons, vans and similar type installations where a loose radio could be extremely dangerous to the vehicle occupants.

CONTROL UNIT

The Control Unit should be mounted within convenient reach of the operator, and located so that it will not interfere with safe operation of the vehicle. Normally, the Control Unit is mounted on the underside and in the middle of the instrument panel. Use the swivel bracket from the Control Unit as a template for locating two mounting holes. Mount the Control Unit as shown in Figure 5. After mounting the unit, connect the numbered leads in the Power/Control Cable to the corresponding numbered pins on the back of the Control Unit. Connect the Ignition Switch Cables as shown in Figure 8.

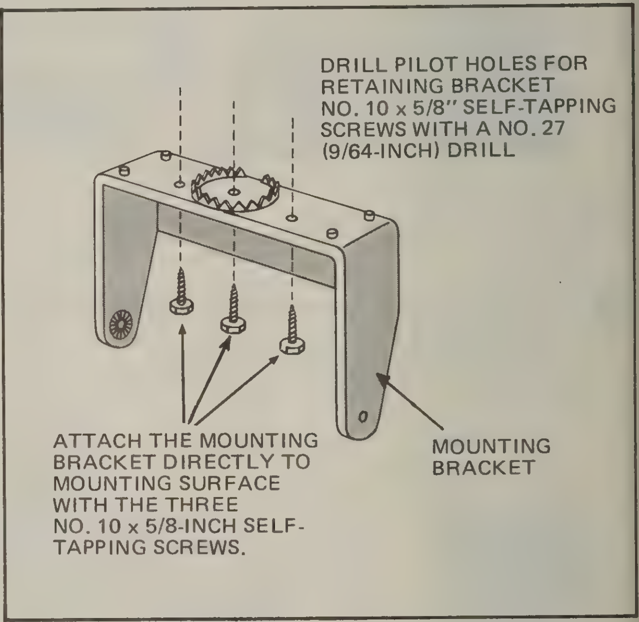

GENERAL ELECTRIC
MASTR
POWER/CONTROL JACK
SPEAKER JACK
IGNITION SWITCH CABLE
BK
TO GRD.
FOR CONTROL CABLE STRAIN RELIEF HOOK

DRILL PILOT HOLES WITH A NO. 27 (9/64-INCH) DRILL. ATTACH BRACKET TO MOUNTING SURFACE WITH TWO NO. 10 x 5/8" SELF-TAPPING SCREWS.

Figure 5 — Mounting the Control Unit

SPEAKER

The speaker should be mounted where it will direct sound to the operator, but not interfere with his vision or provide a hazard to passengers in case of an accident. The speaker may be mounted on the lower edge of the instrument panel, on the firewall, above the windshield in some trucks, or behind the built-in speaker grille in some vehicles. Use the mounting bracket as a template for locating the mounting holes, and mount the speaker as shown in Figure 6.


MOUNTING BRACKET

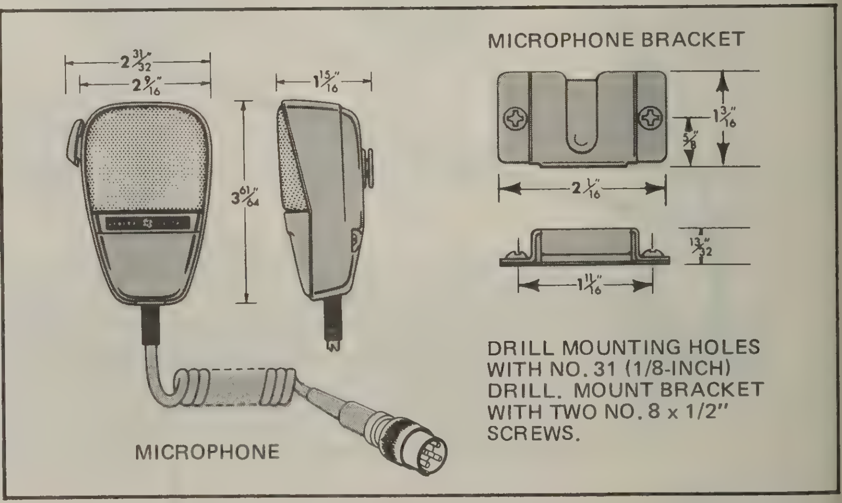
DRILL PILOT HOLES FOR RETAINING BRACKET NO. 10 x 5/8" SELF-TAPPING SCREWS WITH A NO. 27 (9/64-INCH) DRILL

ATTACH THE MOUNTING BRACKET DIRECTLY TO MOUNTING SURFACE WITH THE THREE NO. 10 x 5/8-INCH SELF-TAPPING SCREWS.

Figure 6 — Mounting the Speaker

MICROPHONE

Mount the microphone near the Control Unit where it will be within easy reach of the operator but will not interfere with safe operation of the vehicle. After the microphone bracket is mounted (Figure 7), screw the microphone connector into the microphone jack on the bottom of the Control Unit.


2 31/32"
2 9/16"
1 15/16"
3 61/64"
MICROPHONE
MICROPHONE BRACKET
1 3/16"
5/8"
2 1/16"
13/32"
1 11/16"

DRILL MOUNTING HOLES WITH NO. 31 (1/8-INCH) DRILL. MOUNT BRACKET WITH TWO NO. 8 x 1/2" SCREWS.

Figure 7 — Mounting the Microphone

IGNITION SWITCH CABLE

Power to the radio can be controlled by one of the following two methods. Select the type of control desired, and connect the Ignition Switch Cable as directed in the connections chart.

Note: In certain vehicles, the alternator noise level is excessive at the ignition switch terminal. In these cases the yellow lead should be connected directly to the battery.

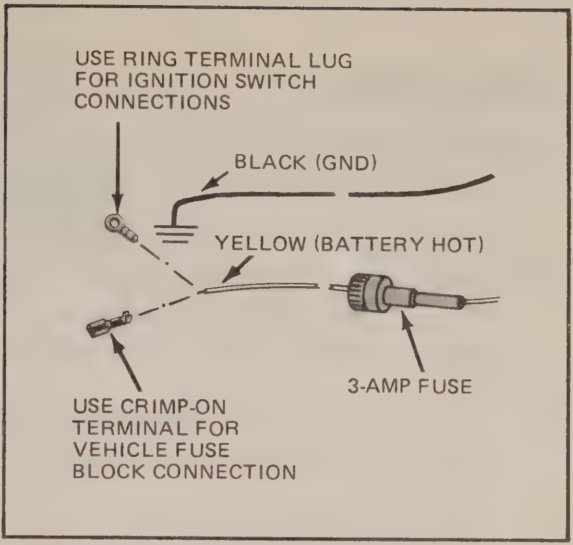

USE RING TERMINAL LUG FOR IGNITION SWITCH CONNECTIONS
BLACK (GND)
YELLOW (BATTERY HOT)
3-AMP FUSE
USE CRIMP-ON TERMINAL FOR VEHICLE FUSE BLOCK CONNECTION

Figure 8 — Ignition Switch Cable

CONTROL METHOD	IGNITION SWITCH CONNECTIONS
1. **Ignition Switch Control** — Transmitter and receiver operate only with ignition switch in Accessory or ON position.	ACCESSORY Terminal
2. **Ignition Switch Bypass** — Transmitter and receiver operate inedependently of ignition. Radio is turned ON and OFF by Control Unit switch.	HOT Terminal

HANDSET & HOOKSWITCH (OPTIONAL)

When the handset is removed from the hookswitch, the speaker is muted, audio is switched to the handset, and the Channel Guard (if present) is disabled. Mount the hookswitch and connect the cable as shown in Figure 9. Next, connect the handset plug to the microphone jack on the bottom of the Control Unit.

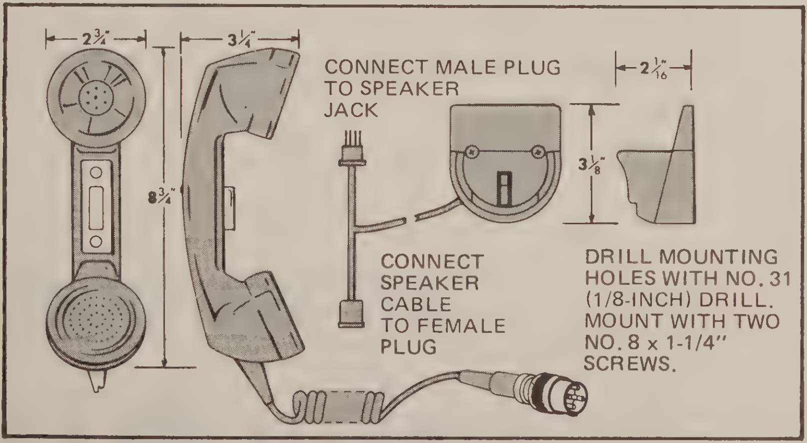

2¾"
3¼"
8¾"
CONNECT MALE PLUG TO SPEAKER JACK
2 1/16"
3⅛"
CONNECT SPEAKER CABLE TO FEMALE PLUG
DRILL MOUNTING HOLES WITH NO. 31 (1/8-INCH) DRILL. MOUNT WITH TWO NO. 8 x 1-1/4" SCREWS.

Figure 9 — Handset and Hookswitch Mounting

ANTENNA

Installation instructions for the antenna are packaged with the antenna. The antenna must be installed in accordance with good engineering practice for optimum results.

For the 138–512 MHz antenna, the most effective mounting position is usually in the center of the roof of the vehicle. The antenna cable will normally run from the front of the Two-Way Radio, behind sections of the interior trim to a door or window post, and then up between the roof and headliner in the passenger compartment to the antenna base.

For the 29.7–50 MHz antenna, the most effective mounting position is usually on the driver's side of the vehicle near the top of the left rear fender or body of the vehicle.

Try to route the cable away from locations where it will be exposed to heat, sharp edges or mechanical damage, and where it will be out of the way of the driver, passengers or vehicle mechanics. Wherever possible, existing holes in the trunk wall, and the channels above or beneath doors and window columns should be utilized.

PLACING THE TWO-WAY RADIO IN OPERATION

After completing the installation of the Two-Way Radio, the following final operations should be performed:

Have an electronics technician who holds a 1st or 2nd Class FCC Radiotelephone license make the final adjustments.

These include:

Transmitter:	Measure Forward and Reflected Power and adjust antenna length for optimum ratio. Set transmitter to rated power output (or to the specific output or input that may be required by the FCC station authorization). Measure the frequency and modulation and enter these measurements on the FCC-required Station Records.
Vehicle:	Check to see if any electrical noise suppression is needed.

Instructions for making these adjustments are included in the Maintenance Manual for the Two-Way Radio. Give the alignment tools (packed with the unit) to the technician.

Fill out and mail the "ON ARRIVAL" Information Card.

Give the Operator's Manual for the Two-Way Radio to the person who is going to operate it, or place the Manual in the vehicle where he will find it.

GENERAL ELECTRIC COMPANY • MOBILE COMMUNICATIONS DIVISION
WORLD HEADQUARTERS • LYNCHBURG, VIRGINIA 24502 U.S.A.

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U.S.A.

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Printed in U.S.A.

MOBILE RADIO

MASTR® *Executive II*
MAINTENANCE MANUAL
SYSTEM BOARD, CRYSTAL MODULES & SYSTEM CABLE ASSEMBLY

Maintenance Manual LBI32569 C

SYSTEM BOARD 19D432662G1

SPECIFICATIONS *

INPUT VOLTAGE	13.8 Volts DC
OUTPUT VOLTAGE (REGULATED)	10.0 Volts DC 8.5 Volts DC 5.4 Volts DC
MAXIMUM CURRENT DRAIN	200 mA max. @ 13.8 VDC
PTT OUTPUT	200 mA min.
EM START OUTPUT	100 mA min.

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specifications are intended primarily for the use of the serviceman. Refer to the appropriate Specification Sheet for the complete specifications.

GENERAL ELECTRIC

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WARNING

Although the highest DC voltage in MASTR Vehicular Repeater Equipment is supplied by the vehicle battery, high currents may be drawn under short circuit conditions. These currents can possibly heat metal objects such as tools, rings, watchbands, etc., enough to cause burns. Be careful when working near energized circuits!

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DESCRIPTION

The system board for the MASTR® Executive II Vehicular Repeater Radio Unit provides interconnections between the control cable from the mobile radio unit and the repeater transmitter and receiver boards that plug into it. It also provides the interconnections with the logic board, the Type 90 encode/decode board and the Channel Guard decode boards for the repeater control.

Mounted on the underside of the radio chassis, the system board is accessible by removing the radio chassis from the mounting frame. Molex pins on the board protrude through slots on the radio chassis to make connections with the exciter and IF-Detector (IF-DET). Molex pins on top of the system board provide harness connections to system jack J1 and the amplifier/antenna switch. The logic board plugs onto molex pins on top of the board. The Type 90 and Channel Guard modules are housed inside holders mounted on the system board. Connections are made through plug-on harnesses.

The system board contains the +10 volt regulator, system control circuits, the audio and squelch circuits for the repeater, transmitter and receiver. An emergency alerting circuitry provides an alerting tone and an external output to activate a customer furnished emergency message device. A frequency selection circuit permits automatic selection of frequencies depended upon the manual selection made at the control unit and the operational condition of the Vehicular Repeater System.

All power and control input connections are made through plug P1 and distributed to their respective board connections through the system cable assembly.

CIRCUIT ANALYSIS

A Block Diagram of the system board is shown in Figure 1. For the circuit analysis description, refer to the system board Schematic Diagram and the Block Diagram in Figure 1.

10 VOLT REGULATOR

The 10 Volt Regulator IC circuit is shown in Figure 2. The 10 Volt regulator includes regulator amplifiers Q1 and Q2 (in the IC) and regulator pass transistor Q18. Q18 is mounted on the edge of the system board and also to the main radio chassis which acts as a heat sink for the transistor. The regulator circuit provides a closely-controlled supply voltage for the repeater exciter, receiver, logic board and the amplifier/antenna switch assembly.

The output of the 10 Volt regulator is then coupled to zener diode VR2 which provides the regulated +8.5 VDC for the Type 90 tone board and the Channel Guard boards. Also this +10 VDC is coupled to zener diode VR3 which provides the regulated +5.4 VDC for the Type 90 encode/decode board.

Turning on the mobile radio unit applies voltage (A+) from the control unit to J901A-10, but the vehicular repeater unit will not be turned on until voltage (A+) is applied to the RPTR ON lead.

In U1 the voltage is applied to the base of Q1 causing it to conduct. This turns on regulator pass transistor Q18 and an output voltage appears at the collector. When the output voltage (at pin 3) reaches 10 volts, zener diode VR1 (in IC) breaks down and Q2 begins conducting.

If the output voltage starts to increase, the base current of Q2 also increases, causing it to conduct harder. This causes Q1 to conduct less decreasing the forward bias on Q18. The voltage drop across Q18 increases and the output remains constant.

When the input voltage starts to drop, the output voltage also tends to drop, causing Q2 to conduct less. This allows Q1 to conduct harder, increasing the forward bias on Q18 and causing it to conduct harder. This reduces the voltage drop across Q18 to keep the output constant.

Service Note: The 10 Volt regulator is protected against short circuits. When supply voltage is present but there is no 10 Volt output, the trouble is probably not in the regulator. Always check for a short (or high drain) on the 10 Volt line before replacing the regulator.

REPEATER RECEIVER AUDIO AND SQUELCH

Volume/squelch Hi from the repeater receiver is applied to J903-1 and branches off to the REPEATER SQUELCH ADJ R25, to the input of op-amp AR1-B, through R27 to the input of the Type 90 tone decoder and to the input of the repeater Channel Guard decoder.

Squelch

The hybrid squelch IC (U3) is a custom flip-chip monolithic integrated circuit. The squelch IC contains the noise amplifier, active noise filter, detector, fast squelch circuits as well as the receiver unsquelch sensor (RUS) switch and carrier activity sensor CAS) switch.

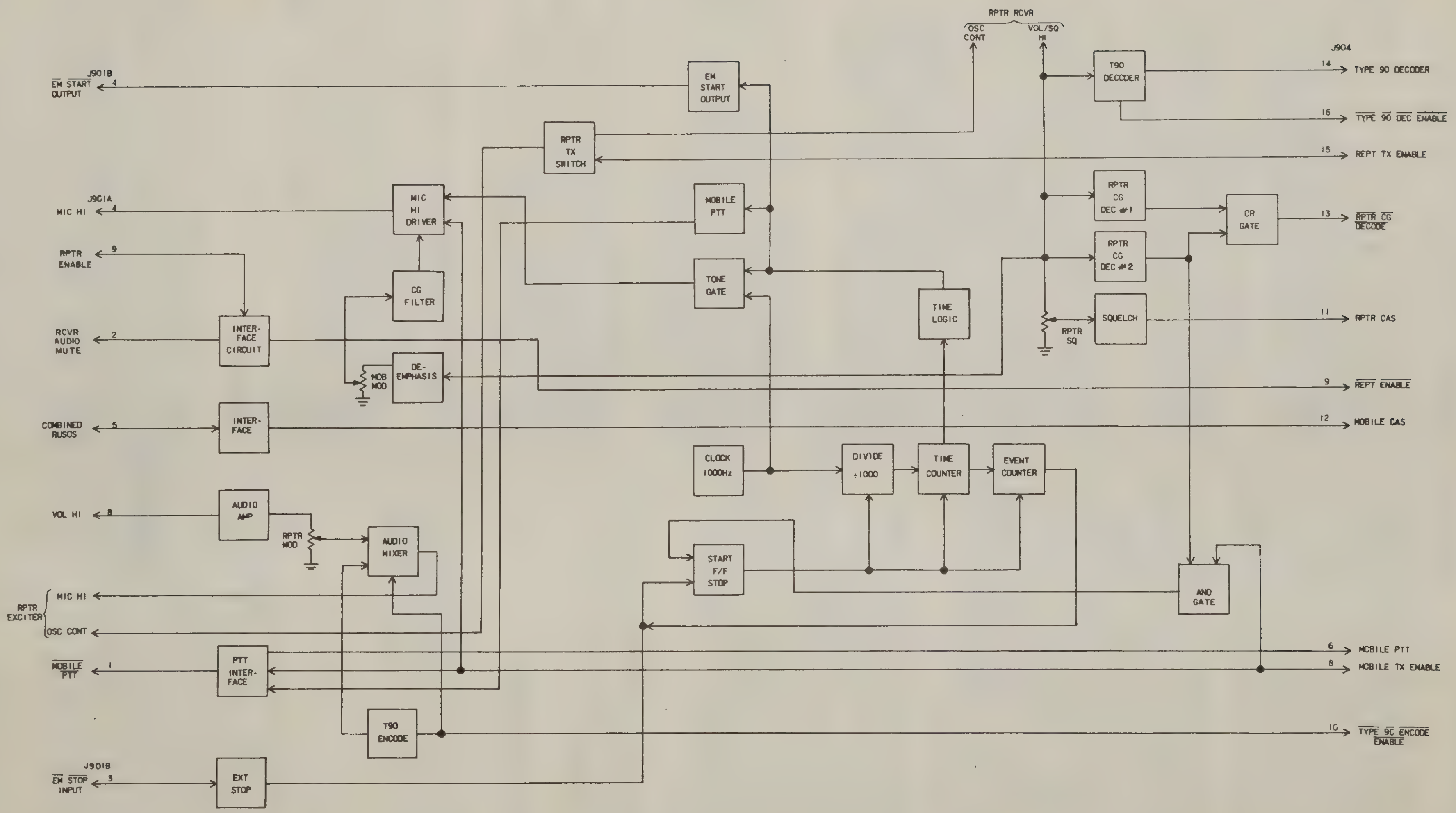
J901B
EM START OUTPUT
4
J901A
MIC HI
4
RPTR ENABLE
9
RCVR AUDIO MUTE
2
COMBINED RUSOS
5
VOL HI
8
RPTR EXCITER
MIC HI
OSC CONT
MOBILE PTT
1
J901B
EM STOP INPUT
3
INTER-FACE CIRCUIT
INTER-FACE
AUDIO AMP
RPTR MOD
PTT INTER-FACE
EXT STOP
MIC HI DRIVER
CG FILTER
DE-EMPHASIS
MOB MOD
AUDIO MIXER
T90 ENCODE
RPTR TX SWITCH
EM START OUTPUT
MOBILE PTT
TONE GATE
CLOCK 1000Hz
START F/F STOP
DIVIDE ÷1000
TIME COUNTER
EVENT COUNTER
TIME LOGIC
RPTR RCVR
OSC CONT
VOL/SQ HI
T90 DECODER
RPTR CG DEC #1
RPTR CG DEC #2
RPTR SQ
SQUELCH
CR GATE
AND GATE
J904
14
TYPE 90 DECODER
16
TYPE 90 DEC ENABLE
15
REPT TX ENABLE
13
RPTR CG DECODE
11
RPTR CAS
9
REPT ENABLE
12
MOBILE CAS
6
MOBILE PTT
8
MOBILE TX ENABLE
10
TYPE 90 ENCODE ENABLE
TE-1463A

Figure 1 - System Board Block Diagram

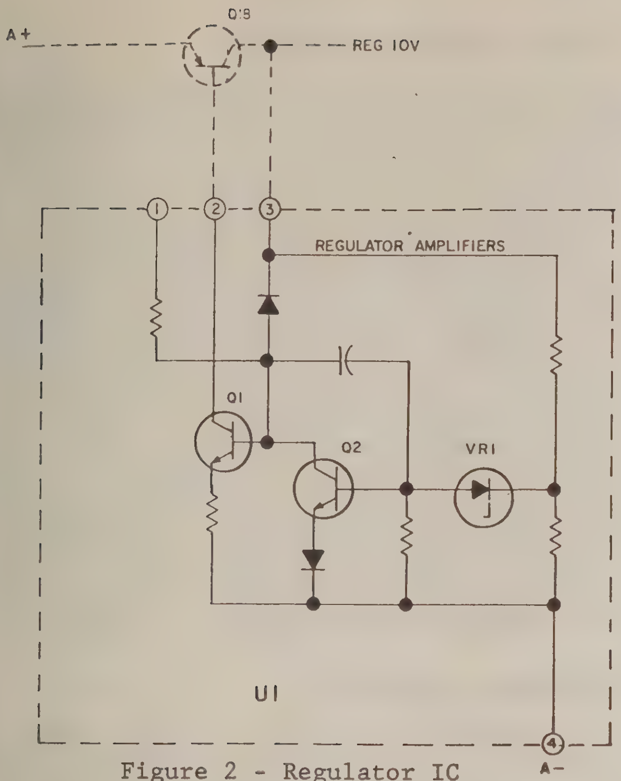

Figure 2 - Regulator IC

Noise Amp, Filter & Active Detector

Noise input from the receiver is coupled through the REPEATER SQUELCH ADJ control R25 to pin 1 on the squelch IC. This signal is applied to the noise amplifier and then to the active filter circuit.

The noise amp and active filter provide the gain and selectivity to distinguish between noise and audio. The filter output drives the active detector circuit to provide the squelch switching functions. Thermistor RT2 keeps the input to the active detector constant over a wide variation in temperature.

Fast Squelch

A signal at or above 20 dB quieting level is sensed by the signal level detector and activates the fast squelch circuit, providing a fast (10 millisecond) squelch operation.

The squelch circuit has one output which controls the CAS switch.

CAS Switch

When the receiver unsquelches, the voltage at pin 6 rises to approximately 10 volts. This voltage is connected to the logic board through J904-11 as Repeater CAS.

Audio

Audio is coupled from the repeater receiver through resistor R101 to the input pin 5 of operational amplifier AR1-B. The output level at pin 7 is adjusted by MOBILE MOD ADJ control R11 to set the repeater deviation of the transmitter. Audio is then coupled through the active Channel Guard Filter which consists of Q2 and associated components that filters out any undesired Channel Guard tone present. From the active filter the audio is then coupled to emitter follower Q3/Q4 to drive the low impedance microphone circuit in the mobile radio unit. Q3/Q4 are gated on from the logic board J904-8.

TYPE 90 TONE

When the audio from the repeater receiver contains a Type 90 tone burst, the tone is coupled through resistor R27 to the input of the Type 90 tone encoder/decoder at P1-7. If the Type 90 tone burst is the proper frequency, the decoder will decode, causing a high output at P1-2. This high output is then coupled to the logic board at J904-14.

MOBILE RECEIVER AUDIO

Mobile receiver audio is coupled through J901A-8 to a 6 dB amplifier consisting of Q21, Q22 and associated components, before being applied to emitter follower Q1. Audio level is adjusted by RPT MOD ADJ R3 before being applied to the Repeater Transmitter Exciter microphone high input lead.

CHANNEL GUARD

The System Board contains two Repeater Channel Guard Decoder boards (A2, A4). If the decoder A2 receives the proper CG tone, the output (CG DET) will switch to a high condition at P1B-2. This high output is then coupled to the input of the inverter to produce low output. The output of the inverter is diode gated through CR9 to J904-13 and then on to the logic board. For additional information on the REPT CG Decode output refer to the Logic Board Maintenance Manual.

A second Channel Guard Decoder Board (A4) is used to detect an emergency signal when received by the vehicular repeater receiver unit. When the proper CG tone is decoded, the output (CG DET) will switch to a high condition at P1D2. This high is coupled to the input of inverter U4-D causing the output of this inverter to switch low. This low is coupled to the emergency start/stop circuitry and also to the logic board via CR10. The emergency alerting circuits will be discussed in a later paragraph.

REPEATER ON-OFF & ENABLE

The Repeater On-Off is controlled from the control unit by applying A+ to J901-9.

The A+ is applied through R117 to the RPTR ENABLE lead. When this lead goes high, diode CR19 is forward biased causing the output at pin 14 of inverter AR1-D to switch low. This low is then coupled to the logic board through J904-9. For additional information on the REPT ENABLE output, refer to the Logic Board Maintenance Manual.

TYPE 90 DECODE ENABLE

The Type 90 Decode Enable input comes from the logic board at J904-16. If this input is high, transistor Q7 is not conducting; however, when the Type 90 Decode Enable lead goes low, transistor Q7 conducts and applies approximately +8.5 VDC to P1-3. For further information on the operation of the Type 90 Encoder/Decoder, refer to the proper Maintenance Manual.

TYPE 90 ENCODE ENABLE

The Type 90 encoder enable operation is the same as described for the Type 90 Decode operation with the addition that when Q8 conducts, a positive voltage (+8.5 VDC) is applied to P1-6 of the Type 90 Encoder/Decoder module A1 and is also used to gate on emitter follower Q5/Q6. Applying this positive voltage to P1A-6 (Encoder Enable) turns on the encoder allowing a tone output at P1A-8. The Tone Out is coupled through operational amplifier AR1-C and then on through emitter follower Q5/Q6 to drive the low impedance microphone circuit of the Repeater Transmitter at J902-4.

MOBILE PTT

Keying the mobile radio from the mobile microphone causes J901A-1 to switch to a low condition, forward biasing diode CR30 and causing the output on pin 1 of inverter AR1-A to switch high. This high output is then coupled to the logic board through J904-6.

When the mobile transmitter is enabled from the logic board, the MOBILE TX ENABLE lead at J904-8 couples a high through CR69 to the base of transistor Q15. This causes Q15 to conduct which then causes Q16 to conduct, forward biasing diode CR29 and keying the mobile transmitter by placing a ground on J901A-1. When Q16 conducts, diode CR31 is also forward biased placing a ground on pin 3 of inverter AR1-A. Since pin 3 of inverter AR1-A is lower in potential than pin 2, the inverter will not switch and the Mobile PTT at J904 will stay high.

Also when the emergency sequence is initiated, the output of U16-10 applies a biasing current to Q15 via R150 and CR56. The PTT lead is pulled to ground as described above.

TRANSMIT/RECEIVE SWITCHING

In the stand-by condition, no input is applied from the logic board (REPT TX ENABLE) at J904-15; therefore, transistors Q11 and Q12 are not conducting. Transistor Q13 is turned on by the base current flowing through resistors R79, R80 and R81 and while Q13 is turned on, approximately +10.0 VDC is applied to the receiver oscillator circuit allowing the Repeater Receiver to receive incoming RF signals. When the REPT TX ENABLE receives a high input from the logic board, this high is coupled to the base of Q11 through R85, turning on Q11. This forward biases diode CR32, turning on transistor Q12. Turning on Q12 applies approximately +10.0 VDC to the Repeater Transmitter Osc Cont lead at J902-1, keying the transmitter. Also this +10.0 VDC is applied to the base of Q13 turning off Q13 which turns off the +10.0 VDC normally applied to the receiver oscillator. This action prevents the Repeater Receiver from receiving its own transmitted signal.

EMERGENCY ALERTING

Additional circuitry on the System Board is used to generate an emergency alerting tone sequence to be transmitted by the mobile transmitter whenever the vehicular repeater receiver detects an emergency type signal from the portable radio unit. The second Channel Guard Decoder Board (A4) is used to detect the proper CG tone associated with the emergency signal and provide an output to this emergency alerting circuitry. Refer to the Tone and Timing Diagram in Figure 3.

An emergency signal containing the proper CG tone is received by the vehicular repeater receiver. The REPT CAS signal is applied to the Logic Board. At the same time the CG tone is decoded by CG Decoder #2 and the output of U4D-11 is applied to the Logic Board REPT CG DECODE through CR10 in addition to the input of U8C-7. The Logic Board recognizes these two inputs, REPT CAS and REPT CG DECODE, and the MOBILE TX ENABLE line goes high. This keys the transmitter as previously described.

The low at U8C-7 is inverted and the resultant high along with the high on the MOBILE TX ENABLE line is applied to NAND gate U7A. NAND gates U7B, U7C, U7D and NOR gate U10B provide the signal to change the state of flip-flops U9A and U9B. When the output of U9-B goes high, the emergency alerting sequence is started.

A high at U9B-4 is applied to U16B and U16C. The high output of U16C is applied to the base of Q26 turning it on. With Q26 conducting Q27 is also turned on to apply a ground on the EM START lead for customer furnished equipment.

A free-running clock consisting of U8A, U8B and associated components provides a

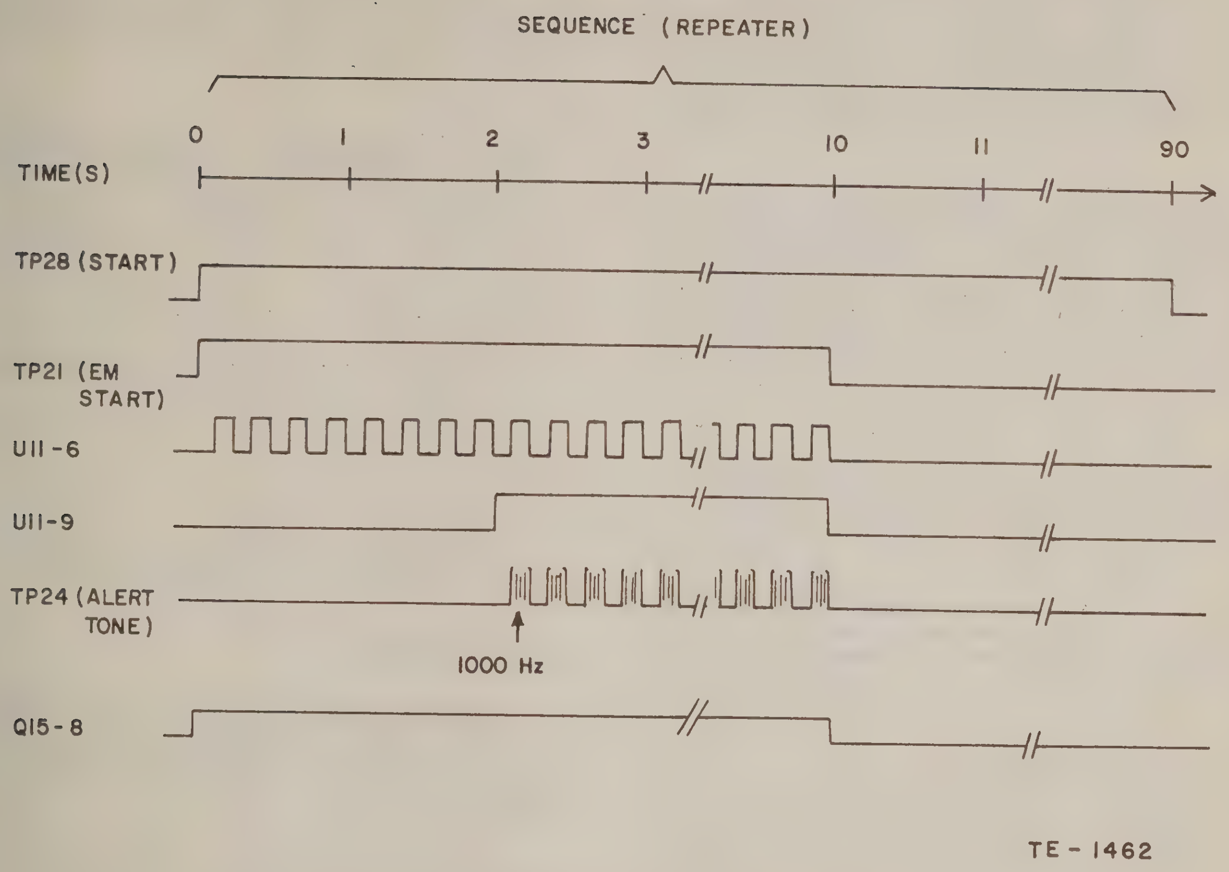

Figure 3 - Emergency Alert Timing Diagram

1000 Hertz signal to Binary Counter (Divider) U12. The divided outputs of U12 are applied to inverters U8D and U8E which generates a clock pulse every 1 second. U13 counts the seconds 0 through 9. After 2 seconds a high is applied to OR gate U10C-8. The high output at U10C-10 is applied to AND gate U11D-12. The high on U11D-13 from U14-3 will then create a high at U11D-11 which is applied to OR gate U17B. The high output at U17B-4 is applied to the control AND gates U11B and U11C and at the same time to the base of Q34. Q34 conducts and clamps the base of Q4 to prevent it from conducting and applying any audio from the vehicular repeater receiver to the mobile transmitter MIKE HI input. The 1000 Hertz clock pulses are also applied to U11B and the repetition rate is controlled by the input on U11C-8. The level of the 1000 Hertz pulses is controlled by R147 before they are applied to the mobile transmitter MIKE HI input through Q32. The repetition rate is 4 pulses per second.

At the end of 10 seconds the carry output of U13 triggers the Count "10" Second U14 clock input. This advances the countdown of U14 by one. This changes the state of U11D which in turn causes the alerting tone pulses to cease. The clamping action on Q4 is removed and the audio from the vehicular repeater receiver can be applied to the mobile transmitter MIKE HI input. The output of U18C changes to low which removes the keying input at the base of Q15, unkeying the mobile transmitter. At the same time Q26 and Q27 cease conducting and the ground is removed from the $\overline{\text{EM START}}$ output on J901B-4.

U13 will resume it's countdown and will only act as a seconds counter for the remaining 80 seconds of the first emergency alerting sequence since the input to U11D-13 has changed state to a low. Each time U13 counts to ten a clock pulse is applied to U14 to advance it by one. When the count reaches 90 seconds, U14-11 goes high. All counters, U12, U13 and U14, are temporarily reset with U14 being advanced by one (event).

The emergency alerting sequence is then repeated four more times (for a total of five). At the completion of the fifth 90 second interval a high from U18A-3 is applied to U17D. The high from U17A-3 resets the start/stop flip-flop and the emergency alerting circuit returns to its quiesent state awaiting its input from the next emergency signal containing the proper Channel Guard decode tone.

The emergency alerting sequence can be stopped by applying a ground to the EM STOP lead at J901B-3. This will cause Q25 to conduct and apply a high to the input of U17A-1 which in turn triggers the start/stop flip-flop to the stop state. Removing power to the vehicular repeater will also interrupt the emergency alerting sequence.

For test purposes the event counter can be advanced at a 1 second rate by connecting TP29 to TP30. Also applying 10V to either TP22 or TP25 will start or stop, respectively, the emergency sequence. Applying +10V to TP26 provides continuous alert tone output (for modulation adjustment). Continuous alert tone output must also have a momentary application of 10V to TP22.

Diodes CR40 through CR52 and jumpers associated with holes H100, H101 and H108 permit changing the duration of keying the mobile transmitter. Also the number of events can be altered by connecting H102 to any of the following (events in parentheses) H103 (1), H106 (2), H105 (3) or H107 (4). The events determine the number of times the emergency alerting sequence keys the mobile radio unit transmitter and sends the alerting tone.

FREQUENCY SELECTION

A separate interface circuitry on the System Board provides automatic frequency selection on the mobile radio unit depended upon inputs from the mobile control unit and the vehicular repeater. This interface circuitry is powered independently from the remaining circuitry on the System Board. A 10 volt zener diode VR4 provides the necessary 10 volts for the operation of this frequency selection circuitry.

When the vehicular repeater is not operational, the mobile radio unit is controlled by the inputs from the control unit as shown in Table 1.

CONTROL UNIT CHANNEL	MOBILE RADIO CHANNEL SELECTED			
	F1	F2	F3	F4
F1	X			
F2		X		
F3			X	
F4				X

Table 1 - Frequency Selection, Vehicular Repeater Not Enabled

When the vehicular repeater is operational and the mobile radio unit is controlled by the inputs from the control unit and the vehicular repeater, the conditions in Table 2 are applicable.

CONTROL UNIT CHANNEL	MOBILE XMTR ENABLED REPEATING	MOBILE RADIO CHANNEL SELECTED			
		F1	F2	F3	F4
F1	X	X			
F2			X		
F2	X	X			
F3	X			X	
F4					X
F4	X			X	

Table 2 - Frequency Selection, Vehicular Repeater Enabled

CRYSTAL MODULE

Crystal modules determine the operating frequency of the transmitter and receiver. The plug-in module contains a crystal, a trimmer capacitor, and varicap for temperature compensation.

The quartz crystals used in the crystal module exhibit the traditional "S" curve characteristics of output frequency versus operating temperature.

In the mid-temperature range (-10°C to +50°C), the raw crystal characteristic is maintained. The compensation voltage which drives the crystal module varicap is approximately constant over this temperature range. Consequently, the crystal almost solely determines the temperature characteristic. The crystals whose temperature characteristic lie toward the high limit of +4 PPM shown in Figure 4 are rotated slightly. All others have little or no rotation.

The cold end temperature characteristic is "lifted" by a temperature-dependent increasing voltage. The compensator which drives the crystal module varicap produces a voltage which increases linearly from -10°C to -30°C. This voltage decreases the varicap capacity, which in turn increases the module tuned circuit frequency to compensate for the decreasing frequency characteristic of the crystal.

The hot end crystal temperature characteristic in Figure 4 is shown to be increasing with temperature. The hot end (above 50°C) crystal characteristic is compensated for by a decreasing voltage from the compensator. This results in added capacity from the varicap. In turn, a decreasing frequency response of the crystal.

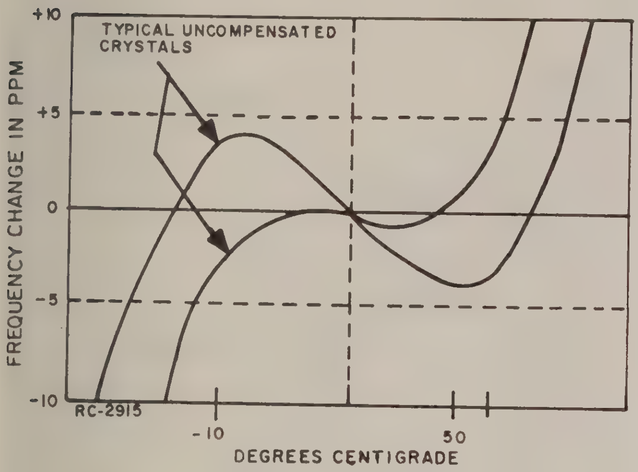

Figure 4 - Typical Crystal Characteristics

Service Note: Proper crystal module operation is dependent on the closely-controlled input voltages from the 10 Volt regulator. Should all of the crystal modules shift off frequency, check the 10 Volt regulator.

Compensation voltage from the exciter is applied to pin 4 of the crystal modules to maintain frequency stability with +5 PPM over a temperature range of -30°C to +60°C.

The compensation voltage varies nonlinearly with temperature to complement the temperature/frequency characteristics of the crystal. The following chart lists typical minimum and maximum voltage readings to be expected at pin 4 of the crystal modules, as measured with a high impedance meter.

TEMPERATURE RANGE	OUTPUT VOLTAGE	
	MINIMUM	MAXIMUM
-30°C	4.9 Volts	6.0 Volts
-10°C to +50 C	3.7 Volts	4.3 Volts
-75°C	3.3 Volts	3.8 Volts

Trimmer capacitor C3 is used to adjust the radio for the exact operating frequency. Refer to the applicable Alignment Procedure for details.

RECEIVER AUDIO MUTING

A receiver audio muting circuit provides the muting of the receiver audio input to the microphone circuit when a ground is applied to J901A-2. The input on H2 of the single tone (ST) switch is normally held high and Q200 is turned off. When the input at H2 goes low, Q200 conducts and a high is applied to output H3 to mute the audio to the microphone circuit from the repeater receiver.

The receiver audio muting circuits mute the VHF receiver during times that the single tone encoder is utilized.

GENERAL ELECTRIC COMPANY• MOBILE COMMUNICATIONS DIVISION
WORLD HEADQUARTERS•LYNCHBURG, VIRGINIA 24502 U.S.A.

GENERAL ELECTRIC*
U.S.A.

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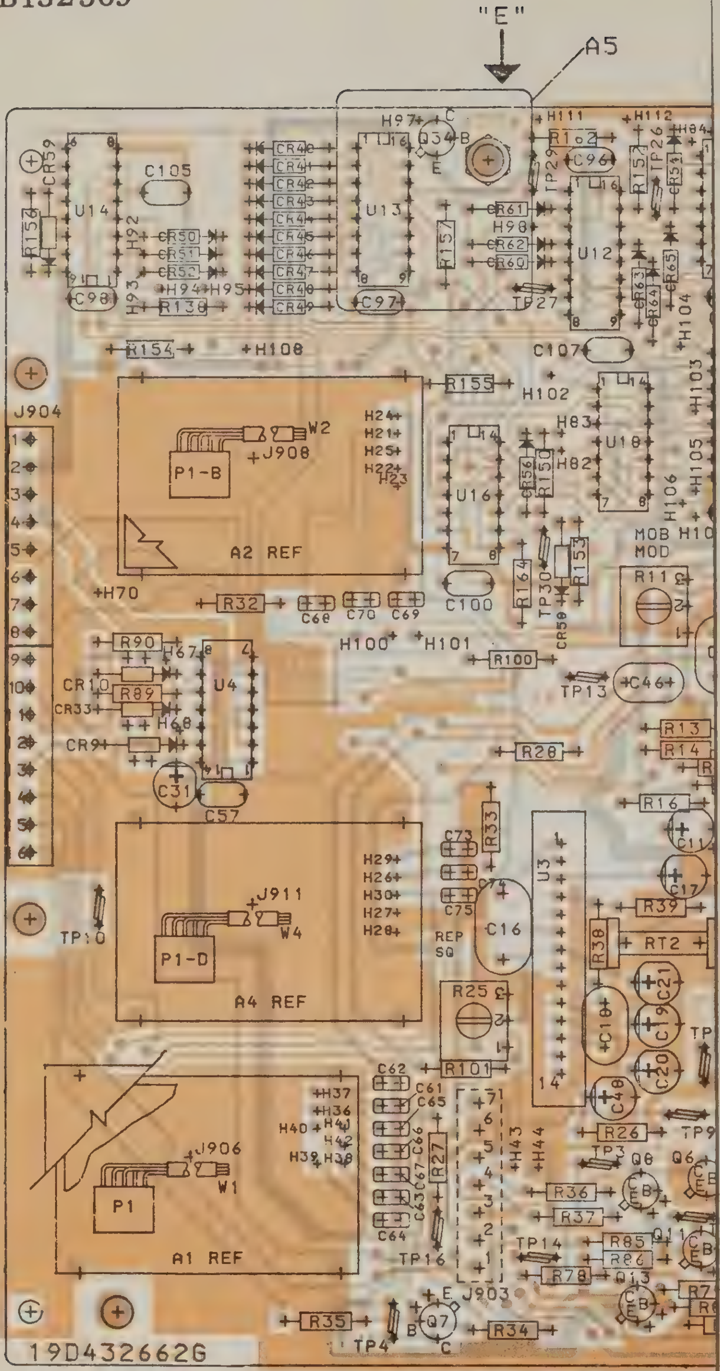
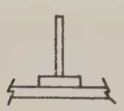
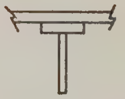
Printed in U.S.A.


"E"
A5
H97
Q34
H111
H112
H84
R102
C96
TP29
TP26
R152
R151
CR59
C105
U14
CR40
CR41
CR42
CR43
CR44
CR45
CR46
CR47
CR48
CR49
U13
CR61
H98
CR62
CR60
U12
R157
R150
H92
CR50
CR51
CR52
H93
H94
H95
R65
R63
R64
C98
R138
C97
TP27
H104
R154
H108
C107
R155
H102
H103
J904
W2
J908
P1-B
H24
H21
H25
H22
H23
A2 REF
H83
U18
H82
U16
R56
R150
H106
H105
MOB MOD
H10
R11
H70
R32
C68
C70
C69
C100
R164
TP30
R153
CR58
H100
H101
R90
H67
CR10
R89
U4
CR33
H68
CR9
R100
TP13
C46
R13
R14
R28
C31
C57
R16
C11
C17
R33
C73
C74
C75
U3
J911
W4
P1-D
A4 REF
H29
H26
H30
H27
H28
TP10
REP SQ
C16
R39
R38
RT2
C21
R25
C18
C19
C20
C48
R101
TP
C62
C61
C65
H37
H36
H40
H41
H42
H39
H38
J906
W1
P1
A1 REF
C66
C67
C63
C64
R27
H43
H44
R26
TP9
TP3
Q8
Q6
R36
R37
Q11
R85
R86
TP14
TP16
R78
Q13
J903
R7
Q7
R35
R34
TP4
19D432662G



VIEW "A"
TYP FOR MOUNTING
J901, J904 & J907

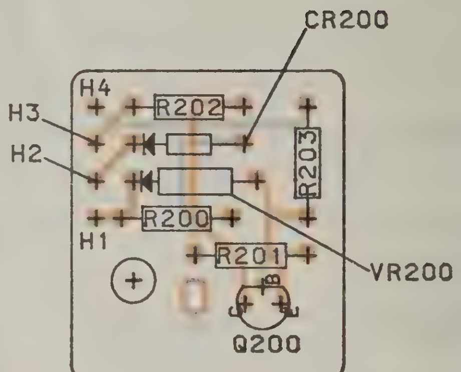


VIEW "B"
TYP FOR MOUNTING
J902 & J903

(19D432662, Rev. 3)
(19A143712, Sh. 1, Rev. 1)
(19A143712, Sh. 2, Rev. 1)

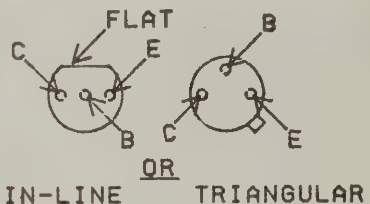
OUTLINE DIAGRAM

SYSTEM BOARD WITH
PWB BOARD REV. 1


CR200
H4
H3
H2
H1
R202
R203
R200
R201
VR200
Q200

RCVR AUDIO MUTE
A5

LEAD IDENTIFICATION
FOR Q1


FLAT
C
E
B
B
C
E
OR
IN-LINE
TRIANGULAR

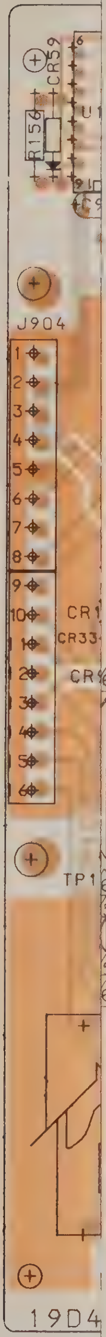
TOP VIEW

LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

(19C331329, Rev. 0)
(19A143965, Sh. 1, Rev. 0)
(19A143965, Sh. 2, Rev. 0)

ER SIDE

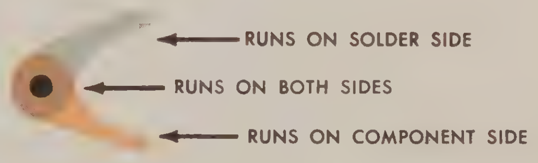
PONENT SIDE


CR59
R156
U1
J904
1
2
3
4
5
6
7
8
9
10
CR1
CR33
1
2
3
4
5
6
CR
TP1
19D4

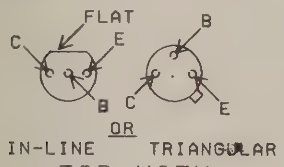
WIRES ARE PART OF A5.

INSTALL ON SOLDER SIDE. WIRES MUST BE NEATLY ROUTED UNDERNEATH COMPONENTS EVERY 1-1/2" OR LESS.

CONNECTION CHART		
FROM	TO	WIRE
W2-O	H21	
W2-BL	H22	
W2-BK	H23	
W2-R	H24	
W2-WGA	H25	
W1-G	H36	
W1-V	H37	
W1-R	H38	
W1-BL	H39	
W1-WGA	H40	
W1-WR	H41	
W1-O	H42	
W4-WGA	H30	
W4-BK	H28	
W4-BL	H27	
W4-R	H29	
W4-O	H26	
H43	H44	DA
H45	H46	DA
R114 NEAR H47	H79	T28G
H67	H81	
H87	H82	
H86	H84	
H83	H89	
H90	H91	
H96	H97	
H98	H99	
H102	H104	
H101	H108	T28G
H109	A5-H1	SF24R
H110	A5-H2	SF24Y
H111	A5-H3	SF24BL
H112	A5-H4	SF24BK
H113	R117 NEAR C103	T28G
H115	H116	T28G


RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE

LEAD IDENTIFICATION
FOR Q1-Q17, Q19-Q31


FLAT
C
E
B
B
C
E
OR
IN-LINE
TRIANGULAR

TOP VIEW

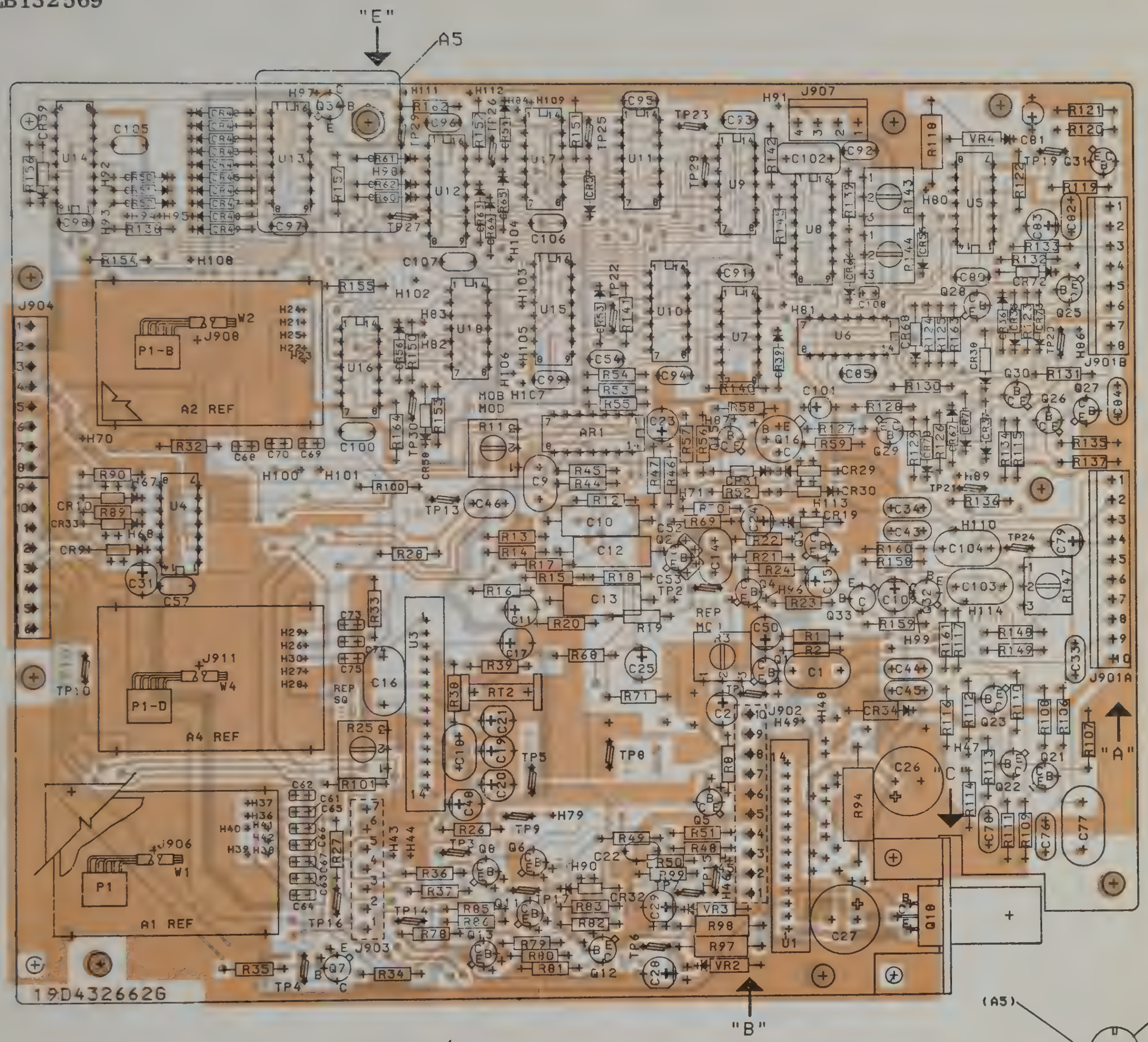
NOTE: LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

VIEW
TYP FOR
J901, J9

OUTLINE DIAGRAM

SYSTEM BOARD WITH
PWB BOARD REV. 0

Issue 2

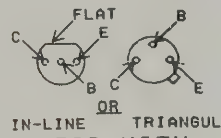

"E"
A5
"A"
"B"
J904
J907
J901B
J901A
J902
J903
P1-B
J908
W2
A2 REF
P1-D
J911
W4
A4 REF
P1
J906
W1
A1 REF
U1
U3
U4
U5
U6
U7
U8
U9
U10
U11
U12
U13
U14
U15
U16
U17
U18
AR1
C26
C27
R94
Q18
VR2
VR3
VR4
TP1
TP2
TP4
TP5
TP8
TP9
TP10
TP13
TP16
19D432662G

△5 WIRES ARE PART OF A5.

△6 INSTALL ON COMPONENT SIDE. WIRES MUST BE NEATLY ROUTED UNDERNEATH COMPONENTS EVERY 1 1/2 IN. OR LESS.

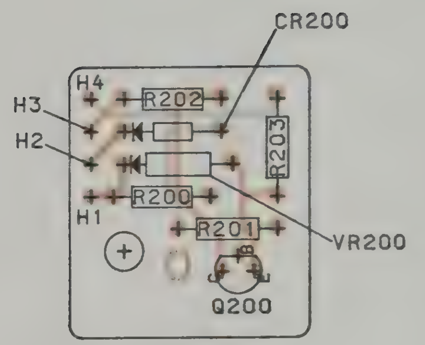
	CONNECTION CHART		
	FROM	TO	WIRE
	W2-O	H21	
	W2-BL	H22	
	W2-BK	H23	
	W2-R	H24	
	W2-WGA	H25	
	W1-G	H36	
	W1-V	H37	
	W1-R	H38	
	W1-BL	H39	
	W1-WGA	H40	
	W1-WR	H41	
	W1-O	H42	
	W4-WGA	H30	
	W4-BK	H28	
	W4-BL	H27	
	W4-R	H29	
	W4-O	H26	
	H43	H44	DA
	H45	H46	DA
△6	H47	H79	T28G
△6	H67	H81	T28G
△6	H87	H82	T28G
△6	H86	H84	T28G
△6	H83	H89	T28G
△6	H90	H91	T28G
△6	H96	H97	T28G
△6	H98	H99	T28G
△6	H102	H104	T28G
△6	H101	H108	T28G
△5	H109	A5-H1	SF24R
△5	H110	A5-H2	SF24Y
△5	H111	A5-H3	SF24BL
△5	H112	A5-H4	SF24BK
△6	H113	H114	T28G

LEAD IDENTIFICATION
FOR Q1-Q17, Q19-Q31


FLAT
C
E
B
B
C
E
IN-LINE
OR
TRIANGULAR

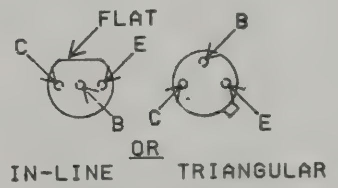
TOP VIEW

NOTE: LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.


CR200
H4
H3
H2
H1
R202
R203
R200
R201
VR200
Q200

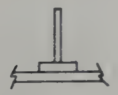
RCVR AUDIO MUTE
A5

LEAD IDENTIFICATION
FOR Q1

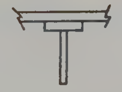

FLAT
C
E
B
B
C
E
IN-LINE
OR
TRIANGULAR

TOP VIEW

NOTE: LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

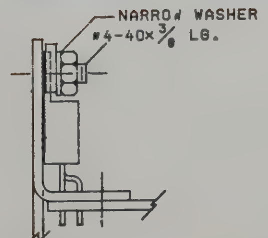


VIEW "A"
TYP FOR MOUNTING
J901, J904 & J907

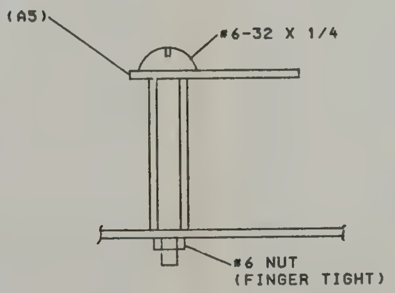


VIEW "B"
TYP FOR MOUNTING
J902 & J903

(19D432662, Rev. 3)
(19A143712, Sh. 1, Rev. 1)
(19A143712, Sh. 2, Rev. 1)


NARROW WASHER
#4-40x3/8 LG.

VIEW "C"
ROTATED 180 DEGREES


(A5)
#6-32 X 1/4
#6 NUT
(FINGER TIGHT)

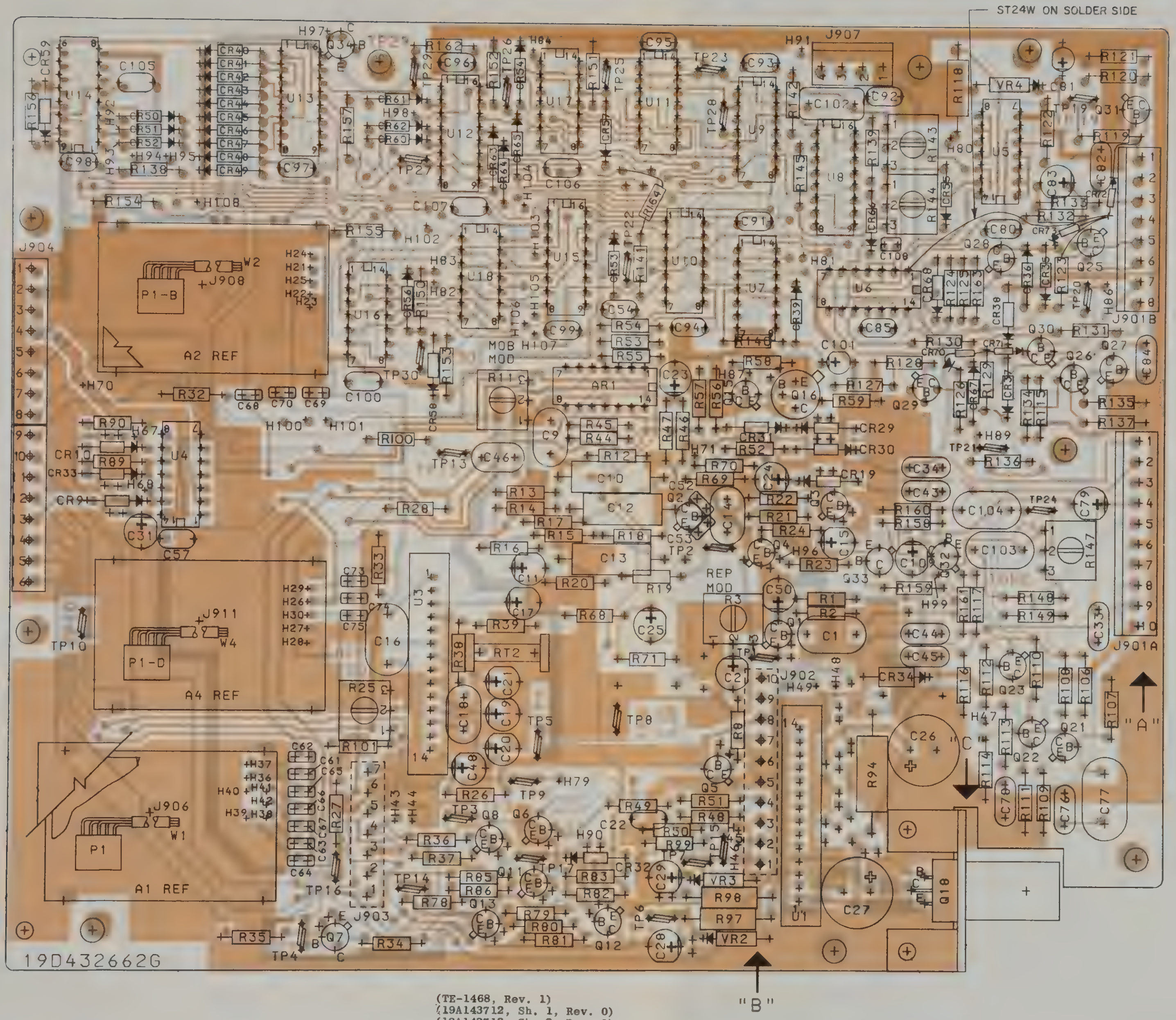
VIEW "E"

RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE

(19C331329, Rev. 0)
(19A143965, Sh. 1, Rev. 0)
(19A143965, Sh. 2, Rev. 0)

OUTLINE DIAGRAM

SYSTEM BOARD WITH PWB BOARD REV. 1

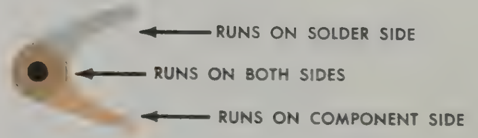

ST24W ON SOLDER SIDE
J907
J904
J908
P1-B
A2 REF
MOB MOD
REF MOD
J911
P1-D
A4 REF
J906
P1
A1 REF
J903
J902
J901B
J901A
"A"
"B"
19D432662G

(TE-1468, Rev. 1)
(19A143712, Sh. 1, Rev. 0)
(19A143712, Sh. 2, Rev. 0)

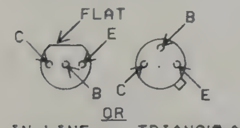
⚠5 WIRES ARE PART OF A5.

⚠6 INSTALL ON SOLDER SIDE. WIRES MUST BE NEATLY ROUTED UNDERNEATH COMPONENTS EVERY 1-1/2" OR LESS.

	CONNECTION CHART		
	FROM	TO	WIRE
	W2-O	H21	
	W2-BL	H22	
	W2-BK	H23	
	W2-R	H24	
	W2-WGA	H25	
	W1-G	H36	
	W1-V	H37	
	W1-R	H38	
	W1-BL	H39	
	W1-WGA	H40	
	W1-WR	H41	
	W1-O	H42	
	W4-WGA	H30	
	W4-BK	H28	
	W4-BL	H27	
	W4-R	H29	
	W4-O	H26	
	H43	H44	DA
	H45	H46	DA
⚠6	R114 NEAR H47	H79	T28G
↑	H67	H81	↑
	H87	H82	
	H86	H84	
	H83	H89	
	H90	H91	
	H96	H97	
	H98	H99	
↓			
	H102	H104	↓
⚠6	H101	H108	T28G
⚠5	H109	A5-H1	SF24R
↑	H110	A5-H2	SF24Y
↓	H111	A5-H3	SF24BL
⚠5	H112	A5-H4	SF24BK
⚠6	H113	R117 NEAR C103	T28G
	H115	H116	T28G

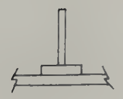

RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE

LEAD IDENTIFICATION
FOR Q1-Q17,Q19-Q31

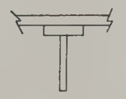

FLAT
C
E
B
B
C
E

IN-LINE OR TRIANGULAR
TOP VIEW

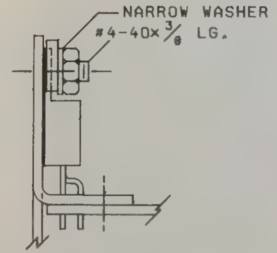
NOTE: LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.



VIEW "A"
TYP FOR MOUNTING
J901, J904 & J907



VIEW "B"
TYP FOR MOUNTING
J902 & J903


NARROW WASHER
#4-40×3/8 LG.

VIEW "C"
ROTATED 180 DEGREES

OUTLINE DIAGRAM

SYSTEM BOARD WITH
PWB BOARD REV. 0

Issue 2

DESCRIPTION
ted wiring: 4 contacts; l.
ical: sim to Concord 10-
ical: sim to Concord 10-
- TRANSISTORS - - - - -
im to Type 2N3904.
im to Type 2N3906.
im to Type 2N3904.
im to Type 2N3906.
im to Type 2N3904.
im to Type 2N3904.
im to Type 2N3906.
im to Type 2N3906.
im to Type 2N3904.
- - RESISTORS - - - - -
lK ohms ±5%, 1/4 w.
t: 10K ohms ±20%, .5 w; s
.2K ohms ±1%, 1/4 w.
t: 1K ohms ±20%, 1/4 w.
5K ohms ±5%, 1/4 w.
0K ohms ±5%, 1/4 w.
.2K ohms ±1%, 1/4 w.
.7K ohms ±1%, 1/4 w.
.5K ohms ±1%, 1/4 w.
.2K ohms ±1%, 1/4 w.
.7K ohms ±1%, 1/4 w.
0 ohms ±1%, 1/4 w.
K ohms ±1%, 1/4 w.
00K ohms ±5%, 1/4 w.
20K ohms ±5%, 1/4 w.
3K ohms ±5%, 1/4 w.
K ohms ±5%, 1/4 w.
t: 10K ohms ±20%, .5 w; s
7 ohms ±5%, 1/4 w.
2K ohms ±5%, 1/4 w.
5K ohms ±5%, 1/4 w.
2K ohms ±5%, 1/4 w.

BOL	GE PART NO.	DESCRIPTION
		- - - - - - - INTEGRATED CIRCUITS - - - - - - -
	19D416564G4	Regulator, 10 v.
	19D416560G3	I.C. Squelch Hybrid.
	19A134097P9	Digital, Quad 2-Input Nand Gate: Identification No. 4011.
	19A134097P341	Digital, Hex Buffer/Converter (Inverting): Identification No. 4049 UB.
	19A134097P2	Digital, Quad 2-Input Nor Gate: Identification No. 4001.
	19A134097P55	Digital, Quad (2) Input Or Gate: Identification No. 4071.
	19A134097P56	Digital, Quad (2) Input & Gate: Identification No. 4081.
	19A134097P33	Digital, 12-Stage Binary Ripple Counter: Identification No. 4040.
	19A134097P15	Digital, Decade Counter Divider: Identification No. 4017.
	19A134097P56	Digital, Quad (2) Input & Gate: Identification No. 4081.
	19A134097P55	Digital, Quad (2) Input Or Gate: Identification
		- - - - - - - - - VOLTAGE REGULATORS - - - - - -
	4036887P9	Zener: 500 mW, 8.5 v. nominal.
	4036887P5	Zener: 500 mW, 5.4 v. nominal.
	4036887P11	Zener: 500 mW, 10.0 v. nominal.
		- - - - - - - - - - CABLES - - - - - - - - - -
	19B232887G2	Cable. Includes (P1).
	19B232887G3	Cable. Includes (P1).
	19B232887G3	Cable. Includes (P1).
		- - - - - - - - - MISCELLANEOUS - - - - - - - -
	4036555P1	Insulator, washer: nylon. (Used with Q16).
	19A116023P3	Insulator, plate. (Used with Q18).
	19A134016P1	Insulator, bushing. (Used with Q18).
	19B232899P1	Heat sink. (Used with Q18).
	19B200525P155	Rivet, tubular. (Secures Q18 heat sink).
	19B232778G1	Can. (A1, A2 & A4).
	19A137867G1	Cover. (A1, A2 & A4).
	19A137865G1	Insulator. (Used with A1, A2 & A4).
	19A137866P1	Insulator. (Located between plug P1 & Covers).
	19B201955P1	Spacer. (Used with A5).

PARTS LIST

SYSTEM BOARD

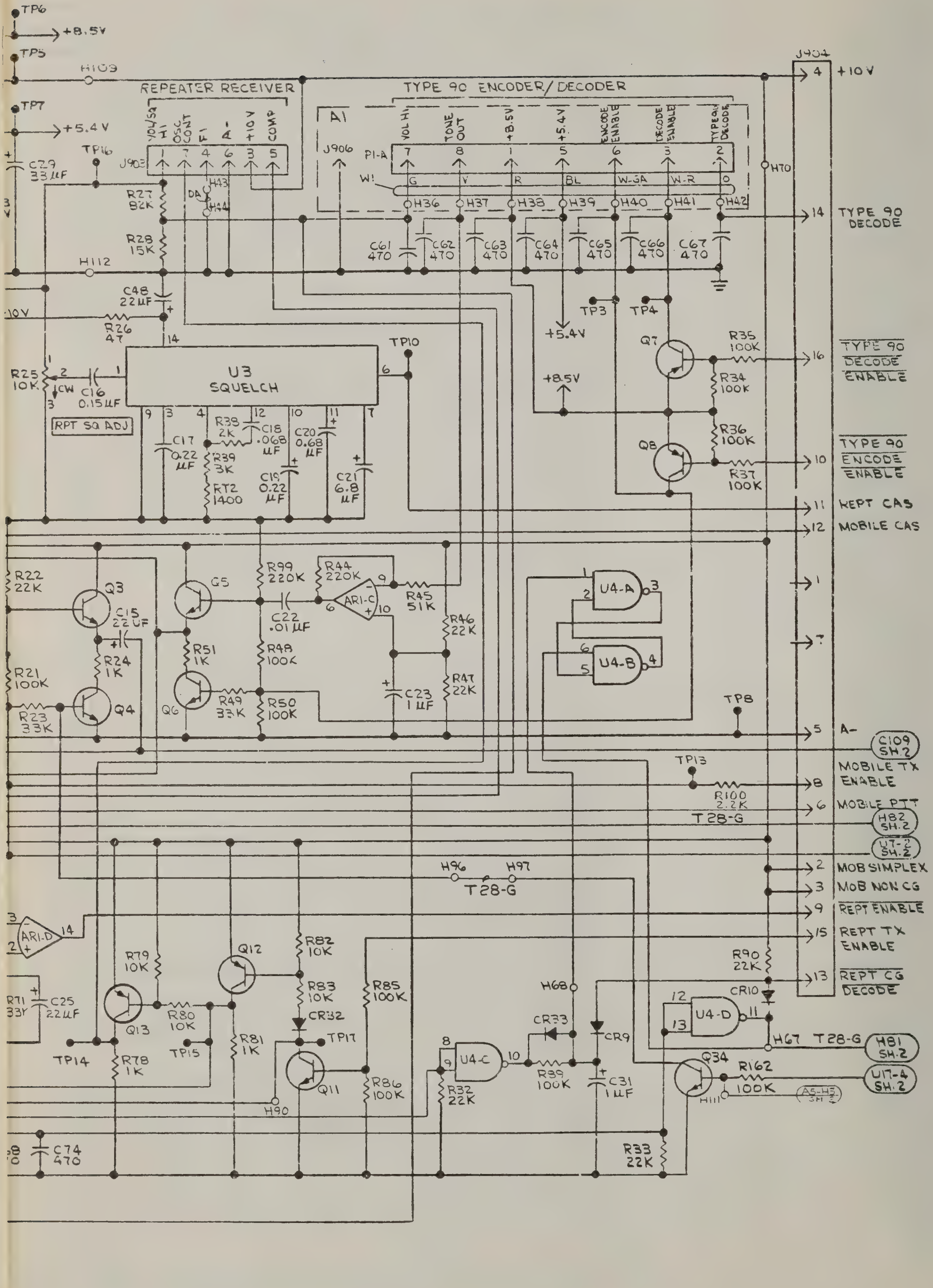
PARTS LIST

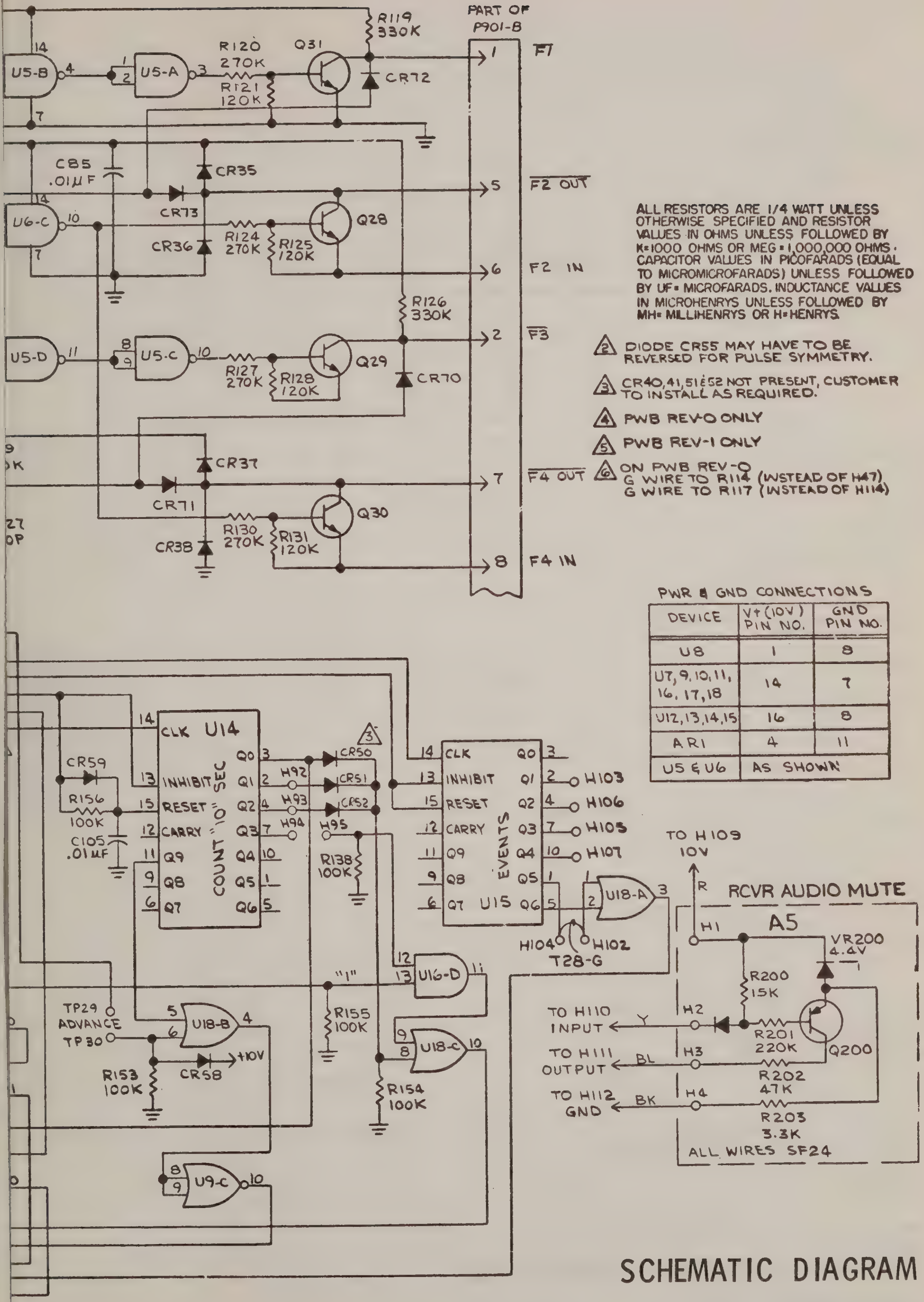
SYSTEM BOARD
19D432662G1

Issue 3

SYMBOL	GE PART NO.	DESCRIPTION
A1		Type 90 Encoder/Decoder.
A2		Repeater Channel Guard Decoder No. 1.
A4		Repeater Channel Guard Decoder No. 2.
AR1	19A134511P1	Integrated circuit, linear: Quad OP AMP; sim to NSCLM 224N or MLM 224P.
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C1	19A116080P7	Polyester: 0.1 µf ±20%, 50 VDCW.
C2	19A134202P14	Tantalum: 1 µf ±20%, 35 VDCW.
C9	19A116080P6	Polyester: 0.068 µf ±20%, 50 VDCW.
C10	19C300075P33001G	Polyester: 0.033 µf ±2%, 100 VDCW; sim to GE Type 61F.
C11	19A134202P10	Tantalum: 0.22 µf ±20%, 35 VDCW.
C12	19C300075P33001G	Polyester: 0.033 µf ±2%, 100 VDCW; sim to GE Type 61F.
C13	19C300075P68001G	Polyester: 0.068 µf ±2%, 100 VDCW; sim to GE Type 61F.
C14	19A116080P105	Polyester: 0.047 µf ±10%, 50 VDCW.
C15	19A134202P6	Tantalum: 22 µf ±20%, 15 VDCW.
C16	19A116080P8	Polyester: 0.15 µf ±20%, 50 VDCW.
C17	19A134202P110	Tantalum: 0.22 µf ±10%, 35 VDCW.
C18	19A116080P106	Polyester: 0.068 µf ±10%, 50 VDCW.
C19	19A134202P110	Tantalum: 0.22 µf ±10%, 35 VDCW.
C20	19A134202P13	Tantalum: 0.68 µf ±20%, 35 VDCW.
C21	19A134202P15	Tantalum: 6.8 µf ±20%, 35 VDCW.
C22	19A116080P1	Polyester: 0.01 µf ±20%, 50 VDCW.
C23 and C24	19A134202P14	Tantalum: 1 µf ±20%, 35 VDCW.
C25	19A134202P6	Tantalum: 22 µf ±20%, 15 VDCW.
C26 and C27	19A134319P1	Electrolytic: 220 µf +75-10%, 25 VDCW; sim to Sprague Type 502D182.
C28 and C29	19A134202P4	Tantalum: 33 µf ±20%, 10 VDCW.
C31	19A134202P14	Tantalum: 1 µf ±20%, 35 VDCW.
C33 and C34	19A116655P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C43 thru C45	19A116655P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C46	19A116080P105	Polyester: 0.047 µf ±10%, 50 VDCW.
C48	19A134202P6	Tantalum: 22 µf ±20%, 15 VDCW.
C50	19A134202P6	Tantalum: 22 µf ±20%, 15 VDCW.
C52 and C53	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-A050-W5R-471M.
C54	19A116080P1	Polyester: 0.01 µf ±20%, 50 VDCW.
C57	19A116080P1	Polyester: 0.01 µf ±20%, 50 VDCW.
C61 thru C70	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-A050-W5R-471M.
C73 thru C75	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-A050-W5R-471M.
C76	19A116655P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C77	19A116080P9	Polyester: 0.22 µf ±20%, 50 VDCW.
C78	19A116655P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C79	19A134202P6	Tantalum: 22 µf ±20%, 15 VDCW.
C80	19A116080P1	Polyester: 0.01 µf ±20%, 50 VDCW.
C81	19A134202P14	Tantalum: 1 µf ±20%, 35 VDCW.
C82	19A116655P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C83	19A134202P6	Tantalum: 22 µf ±20%, 15 VDCW.
C84	19A116655P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C85	19A116080P1	Polyester: 0.01 µf ±20%, 50 VDCW.
C91 thru C100	19A116080P1	Polyester: 0.01 µf ±20%, 50 VDCW.
C101	19A134202P14	Tantalum: 1 µf ±20%, 35 VDCW.
C102	5493366P1000J	Mica: 1000 pf ±5%, 100 VDCW; sim to Electro Motive Type DM-15.
C103 and C104	19A116080P7	Polyester: 0.1 µf ±20%, 50 VDCW.
C105 thru C107	19A116080P1	Polyester: 0.01 µf ±20%, 50 VDCW.
C108	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie
C109	19A134202P6	Tantalum: 22 µf ±20%, 15 VDCW.
		- - - - - - - - - - DIODES AND RECTIFIERS - - - - - -
CR9 and CR10	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
CR19	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
CR29	4037822P1	Silicon, 1000 mA, 400 PIV.
CR30 thru CR33	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
CR34	4037822P1	Silicon, 1000 mA, 400 PIV.
CR35 thru CR68	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
CR70 thru CR73	19A115250P1	silicon, fast recovery, 225mA, 50 PIV.
		- - - - - - - - - - JACKS AND RECEPTACLES - - - - -
J901A	19A116659P109	Connector, printed wiring: 10 contacts; sim to Molex 09-60-1101.
J901B	19A116659P107	Connector, printed wiring: 8 contacts; sim to Molex 09-60-1081.
J902	19A116659P29	Connector, printed wiring: 10 contacts; sim to Molex 09-64-1103.
J903	19B219594P1	Contact, electrical: 7 pins.
J904	19A116659P40	Connector, printed wiring: 8 contacts; sim to Molex 09-64-1082. (Quantity 2).
J906	19A116366P6	Contact, electrical: sim to Concord 10-891-2.
J907	19A116659P103	Connector, printed wiring: 4 contacts; sim to Molex 09-60-1041.
J908	19A116366P6	Contact, electrical: sim to Concord 10-891-2.
J911	19A116366P6	Contact, electrical: sim to Concord 10-891-2.
		- - - - - - - - - - TRANSISTORS - - - - - - - - -
Q1 thru Q6	19A115910P1	Silicon, NPN; sim to Type 2N3904.
Q7 and Q8	19A115852P1	Silicon, PNP; sim to Type 2N3906.
Q11	19A115910P1	Silicon, NPN; sim to Type 2N3904.
Q12 and Q13	19A115852P1	Silicon, PNP; sim to Type 2N3906.
Q15	19A115910P1	Silicon, NPN; sim to Type 2N3904.
Q16	19A115300P4	Silicon, NPN.
Q18	19A116375P1	Silicon, PNP.
Q21	19A115910P1	Silicon, NPN; sim to Type 2N3904.
Q22 and Q23	19A115852P1	Silicon, PNP; sim to Type 2N3906.
Q25	19A115852P1	Silicon, PNP; sim to Type 2N3906.
Q26 thru Q34	19A115910P1	Silicon, NPN; sim to Type 2N3904.
		- - - - - - - - - - - RESISTORS - - - - - - - - - -
R1 and R2	3R152P513J	Composition: 51K ohms ±5%, 1/4 w.
R3	19A116559P106	Variable, cermet: 10K ohms ±20%, .5 w; sim to CTS Series 360.
R8	19C314256P21622	Metal film: 16.2K ohms ±1%, 1/4 w.
R11	19A700109P1	Variable, cermet: 1K ohms ±20%, 1/4 w.
R12	19A700106P91	Composition: 15K ohms ±5%, 1/4 w.
R13	19A700106P87	Composition: 10K ohms ±5%, 1/4 w.
R14	19C314256P21622	Metal film: 16.2K ohms ±1%, 1/4 w.
R15	19C314256P21472	Metal film: 14.7K ohms ±1%, 1/4 w.
R16	19C314256P21652	Metal film: 16.5K ohms ±1%, 1/4 w.
R17	19C314256P27321	Metal film: 73.2K ohms ±1%, 1/4 w.
R18	19C314256P21472	Metal film: 14.7K ohms ±1%, 1/4 w.
R19	19C314256P22000	Metal film: 200 ohms ±1%, 1/4 w.
R20	19C314256P21002	Metal film: 10K ohms ±1%, 1/4 w.
R21	19A700106P111	Composition: 100K ohms ±5%, 1/4 w.
R22	3R152P224J	Composition: 220K ohms ±5%, 1/4 w.
R23	19A700106P99	Composition: 33K ohms ±5%, 1/4 w.
R24	19A700106P63	Composition: 1K ohms ±5%, 1/4 w.
R25	19A116559P106	Variable, cermet: 10K ohms ±20%, .5 w; sim to CTS Series 360.
R26	19A700106P31	Composition: 47 ohms ±5%, 1/4 w.
R27	19A700106P109	Composition: 82K ohms ±5%, 1/4 w.
R28	19A700106P91	Composition: 15K ohms ±5%, 1/4 w.
R32 and R33	19A700106P95	Composition: 22K ohms ±5%, 1/4 w.
R34 thru R37	19A700106P111	Composition: 100K ohms ±5%, 1/4 w.
R38	3R152P202J	Composition: 2K ohms ±5%, 1/4 w.
R39	3R152P302J	Composition: 3K ohms ±5%, 1/4 w.
R44	3R152P224J	Composition: 220K ohms ±5%, 1/4 w.
R45	3R152P513J	Composition: 51K ohms ±5%, 1/4 w.
R46 and R47	19A700106P95	Composition: 22K ohms ±5%, 1/4 w.
R48	19A700106P111	Composition: 100K ohms ±5%, 1/4 w.
R49	19A700106P99	Composition: 33K ohms ±5%, 1/4 w.
R50	19A700106P111	Composition: 100K ohms ±5%, 1/4 w.
R51	19A700106P63	Composition: 1K ohms ±5%, 1/4 w.
R52	19A700106P87	Composition: 10K ohms ±5%, 1/4 w.
R53 and R54	19A700106P95	Composition: 22K ohms ±5%, 1/4 w.
R55	19A700106P71	Composition: 2.2K ohms ±5%, 1/4 w.
R56	19A700106P95	Composition: 22K ohms ±5%, 1/4 w.
R57 and R58	19A700106P111	Composition: 100K ohms ±5%, 1/4 w.
R59	19A700106P95	Composition: 22K ohms ±5%, 1/4 w.
R68	19A700106P107	Composition: 68K ohms ±5%, 1/4 w.
R69	19A700106P111	Composition: 100K ohms ±5%, 1/4 w.
R70	19A700106P95	Composition: 22K ohms ±5%, 1/4 w.
R71	19A700106P99	Composition: 33K ohms ±5%, 1/4 w.
R78	19A700106P63	Composition: 1K ohms ±5%, 1/4 w.
R79 and R80	19A700106P87	Composition: 10K ohms ±5%, 1/4 w.
R81	19A700106P63	Composition: 1K ohms ±5%, 1/4 w.
R82 and R83	19A700106P87	Composition: 10K ohms ±5%, 1/4 w.
R85 thru R89	19A700106P111	Composition: 100K ohms ±5%, 1/4 w.
R90	19A700106P95	Composition: 22K ohms ±5%, 1/4 w.
R94	19A700050P7	Wirewound: 0.33 ohms ±10%, 2 w.
R97	19A700113P21	Composition: 18 ohms ±5%, 1/2 w.
R98	19A700113P36	Composition: 75 ohms ±5%, 1/2 w.
R99	3R152P224J	Composition: 220K ohms ±5%, 1/4 w.
R100	19A700106P71	Composition: 2.2K ohms ±5%, 1/4 w.
R101	19A700019P50	Deposited Carbon: 12K ohms ±5%, 1/4 w.
R106	3R152P274J	Composition: 270K ohms ±5%, 1/4 w.
R107	19A700106P111	Composition: 100K ohms ±5%, 1/4 w.
R108 and R109	19A700106P87	Composition: 10K ohms ±5%, 1/4 w.
R110	19A700106P75	Composition: 3.3K ohms ±5%, 1/4 w.
R111	19A700106P87	Composition: 10K ohms ±5%, 1/4 w.
R112	19A700106P79	Composition: 4.7K ohms ±5%, 1/4 w.
R113 and R114	19A700106P87	Composition: 10K ohms ±5%, 1/4 w.
R115 thru R117	19A700106P95	Composition: 22K ohms ±5%, 1/4 w.
R118	19A700113P63	Composition: 1K ohms ±5%, 1/2 w.
R119	3R152P334J	Composition: 330K ohms ±5%, 1/4 w.
R120	3R152P274J	Composition: 270K ohms ±5%, 1/4 w.
R121	3R152P124J	Composition: 120K ohms ±5%, 1/4 w.
R122	3R152P224J	Composition: 220K ohms ±5%, 1/4 w.
R123	3R152P334J	Composition: 330K ohms ±5%, 1/4 w.
R124	3R152P274J	Composition: 270K ohms ±5%, 1/4 w.
R125	3R152P124J	Composition: 120K ohms ±5%, 1/4 w.
R126	3R152P334J	Composition: 330K ohms ±5%, 1/4 w.
R127	3R152P274J	Composition: 270K ohms ±5%, 1/4 w.
R128	3R152P124J	Composition: 120K ohms ±5%, 1/4 w.
R129	3R152P334J	Composition: 330K ohms ±5%, 1/4 w.
R130	3R152P274J	Composition: 270K ohms ±5%, 1/4 w.
R131	3R152P124J	Composition: 120K ohms ±5%, 1/4 w.
R132	19A700106P55	Composition: 470 ohms ±5%, 1/4 w.
R133	19A700106P63	Composition: 1K ohms ±5%, 1/4 w.
R134	19A700106P71	Composition: 2.2K ohms ±5%, 1/4 w.
R135	19A700106P95	Composition: 22K ohms ±5%, 1/4 w.
R136 and R137	19A700106P107	Composition: 4.7 ohms ±5%, 1/4 w.
R138	19A700106P111	Composition: 100K ohms ±5%, 1/4 w.
R139 and R140	3R152P105J	Composition: 1.0 megohm ±5%, 1/4 w.
R141	19A700106P111	Composition: 100K ohms ±5%, 1/4 w.
R142	3R152P824J	Composition: 820K ohms ±5%, 1/4 w.
R143	19A116559P127	Variable, cermet: 100K ohms ±20%, .5 w; sim to CTS Series 360.
R144	19A116559P109	Variable, cermet: K ohms ±20%, 0.36 w; sim to CTS Series 360.
R145	3R152P154J	Composition: 150K ohms ±5%, 1/4 w.
R147	19A116559P106	Variable, cermet: 10K ohms ±20%, .5 w; sim to CTS Series 360.
R148	19A700106P111	Composition: 100K ohms ±5%, 1/4 w.
R149	19A700106P69	Composition: 1.8K ohms ±5%, 1/4 w.
R150	19A700106P95	Composition: 22K ohms ±5%, 1/4 w.
R151 thru R158	19A700106P111	Composition: 100K ohms ±5%, 1/4 w.
R159	19A700106P99	Composition: 33K ohms ±5%, 1/4 w.
R160	3R152P224J	Composition: 220K ohms ±5%, 1/4 w.
R161	19A700106P63	Composition: 1K ohms ±5%, 1/4 w.
R162 and R163	19A700106P111	Composition: 100K ohms ±5%, 1/4 w.
R164	19A700106P95	
		- - - - - - - - - - - - THERMISTORS - - - - - - - -
RT2	5490828P38	Thermistor: 1400 ohms ±5%, color code green & white; sim to Carborundum Type 723H-2.
		- - - - - - - - - TEST POINTS - - - - - - - - - - -
TP1 thru TP10	19B211379P1	Spring (Test Point).
TP13 thru TP17	19B211379P1	Spring (Test Point).
TP19 thru TP30	19B211379P1	Spring (Test Point).
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - - -
U1	19D416564G4	Regulator, 10 v.
U3	19D416560G3	I.C. Squelch Hybrid.
U4 thru U7	19A134097P9	Digital, Quad 2-Input Nand Gate: Identification No. 4011.
U8	19A134097P341	Digital, Hex Buffer/Converter (Inverting): Identification No. 4049 UB.
U9	19A134097P2	Digital, Quad 2-Input Nor Gate: Identification No. 4001.
U10	19A134097P55	Digital, Quad (2) Input Or Gate: Identification No. 4071.
U11	19A134097P56	Digital, Quad (2) Input & Gate: Identification No. 4081.
U12	19A134097P33	Digital, 12-Stage Binary Ripple Counter: Identification No. 4040.
U13 thru U15	19A134097P15	Digital, Decade Counter Divider: Identification No. 4017.
U16	19A134097P56	Digital, Quad (2) Input & Gate: Identification No. 4081.
U17 and U18	19A134097P55	Digital, Quad (2) Input Or Gate: Identification
		- - - - - - - - - - VOLTAGE REGULATORS - - - - - -
VR2	4036887P9	Zener: 500 mW, 8.5 v. nominal.
VR3	4036887P5	Zener: 500 mW, 5.4 v. nominal.
VR4	4036887P11	Zener: 500 mW, 10.0 v. nominal.
		- - - - - - - - - - - CABLES - - - - - - - - - - -
W1	19B232887G2	Cable. Includes (P1).
W2	19B232887G3	Cable. Includes (P1).
W4	19B232887G3	Cable. Includes (P1).
		- - - - - - - - - - MISCELLANEOUS - - - - - - - -
	4036555P1	Insulator, washer: nylon. (Used with Q16).
	19A116023P3	Insulator, plate. (Used with Q18).
	19A134016P1	Insulator, bushing. (Used with Q18).
	19B232899P1	Heat sink. (Used with Q18).
	19B200525P155	Rivet, tubular. (Secures Q18 heat sink).
	19B232778G1	Can. (A1, A2 & A4).
	19A137867G1	Cover. (A1, A2 & A4).
	19A137865G1	Insulator. (Used with A1, A2 & A4).
	19A137866P1	Insulator. (Located between plug P1 & Covers).
	19B201955P1	Spacer. (Used with A5).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES


TP6
+8.5V
TP5
H109
TP7
+5.4 V
TP16
C29 33 µF
REPEATER RECEIVER
VOL/SQ HI
OSC CONT
FI
A-
+10 V
COMP
J903
1 7 4 6 3 5
H43
DA
H44
R27 82K
R28 15K
H112
C48 22 µF
10V
R26 47
R25 10K
CW
C16 0.15 µF
RPT SQ ADJ
U3 SQUELCH
TP10
C17 0.22 µF
R38 2K
C18 .068 µF
R39 3K
RT2 1400
C19 0.22 µF
C20 0.68 µF
C21 6.8 µF
TYPE 90 ENCODER/DECODER
A1
J906
P1-A
W1
VOL HI
TONE OUT
+8.5V
+5.4V
ENCODE ENABLE
DECODE ENABLE
TYPE 90 DECODE
H36 H37 H38 H39 H40 H41 H42
C61 470
C62 470
C63 470
C64 470
C65 470
C66 470
C67 470
TP3
TP4
+5.4V
+8.5V
Q7
Q8
R35 100K
R34 100K
R36 100K
R37 100K
H70
J904
4 +10 V
14 TYPE 90 DECODE
16 TYPE 90 DECODE ENABLE
10 TYPE 90 ENCODE ENABLE
11 REPT CAS
12 MOBILE CAS
1
7
5 A-
C109 SH.2
8 MOBILE TX ENABLE
6 MOBILE PTT
H82 SH.2
U17-2 SH.2
2 MOB SIMPLEX
3 MOB NON CG
9 REPT ENABLE
15 REPT TX ENABLE
13 REPT CG DECODE
H81 SH.2
U17-4 SH.2
R22 22K
Q3
C15 22 µF
R24 1K
R21 100K
R23 33K
Q4
Q5
R51 1K
Q6
R49 33K
R99 220K
C22 .01 µF
R48 100K
R50 100K
R44 220K
AR1-C
R45 51K
R46 22K
R47 22K
C23 1 µF
U4-A
U4-B
TP8
TP13
R100 2.2K
T28-G
H96
H97
T28-G
AR1-D
R71 33K
C25 22 µF
R79 10K
Q13
R80 10K
TP14
R78 1K
TP15
Q12
R81 1K
R82 10K
R83 10K
CR32
TP17
Q11
H90
R85 100K
R86 100K
U4-C
R32 22K
CR33
R39 100K
H68
CR9
C31 1 µF
U4-D
CR10
H67 T28-G
Q34
R162 100K
H111
A5-H5 SH 2
R90 22K
R33 22K
C74 470


PART OF P901-B
R119 330K
R120 270K
R121 120K
Q31
U5-B
U5-A
CR72
F1
C85 .01µF
CR35
CR73
CR36
U6-C
R124 270K
R125 120K
Q28
F2 OUT
F2 IN
R126 330K
U5-D
U5-C
R127 270K
R128 120K
Q29
CR70
F3
CR37
CR71
CR38
R130 270K
R131 120K
Q30
F4 OUT
F4 IN
U14
CLK
INHIBIT
RESET
CARRY
COUNT 10 SEC
CR59
R156 100K
C105 .01µF
CR50
CR51
CR52
H92
H93
H94
H95
R138 100K
U15
EVENTS
H103
H106
H105
H107
U18-A
H104
H102
T28-G
U16-D
"1"
R155 100K
TP29 ADVANCE
TP30
U18-B
R153 100K
CR58
+10V
U18-C
R154 100K
U9-C
TO H109 10V
RCVR AUDIO MUTE
A5
H1
VR200 4.4V
R200 15K
TO H110 INPUT
Y
H2
R201 220K
Q200
TO H111 OUTPUT
BL
H3
R202 47K
TO H112 GND
BK
H4
R203 3.3K
ALL WIRES SF24

ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF=MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH=MILLIHENRYS OR H=HENRYS.

⚠2 DIODE CR55 MAY HAVE TO BE REVERSED FOR PULSE SYMMETRY.

⚠3 CR40,41,51&52 NOT PRESENT, CUSTOMER TO INSTALL AS REQUIRED.

⚠4 PWB REV-0 ONLY

⚠5 PWB REV-1 ONLY

⚠6 ON PWB REV-0
G WIRE TO R114 (INSTEAD OF H47)
G WIRE TO R117 (INSTEAD OF H114)

PWR & GND CONNECTIONS

DEVICE	V+ (10V) PIN NO.	GND PIN NO.
U8	1	8
U7, 9, 10, 11, 16, 17, 18	14	7
U12, 13, 14, 15	16	8
ARI	4	11
U5 & U6	AS SHOWN	

SCHEMATIC DIAGRAM

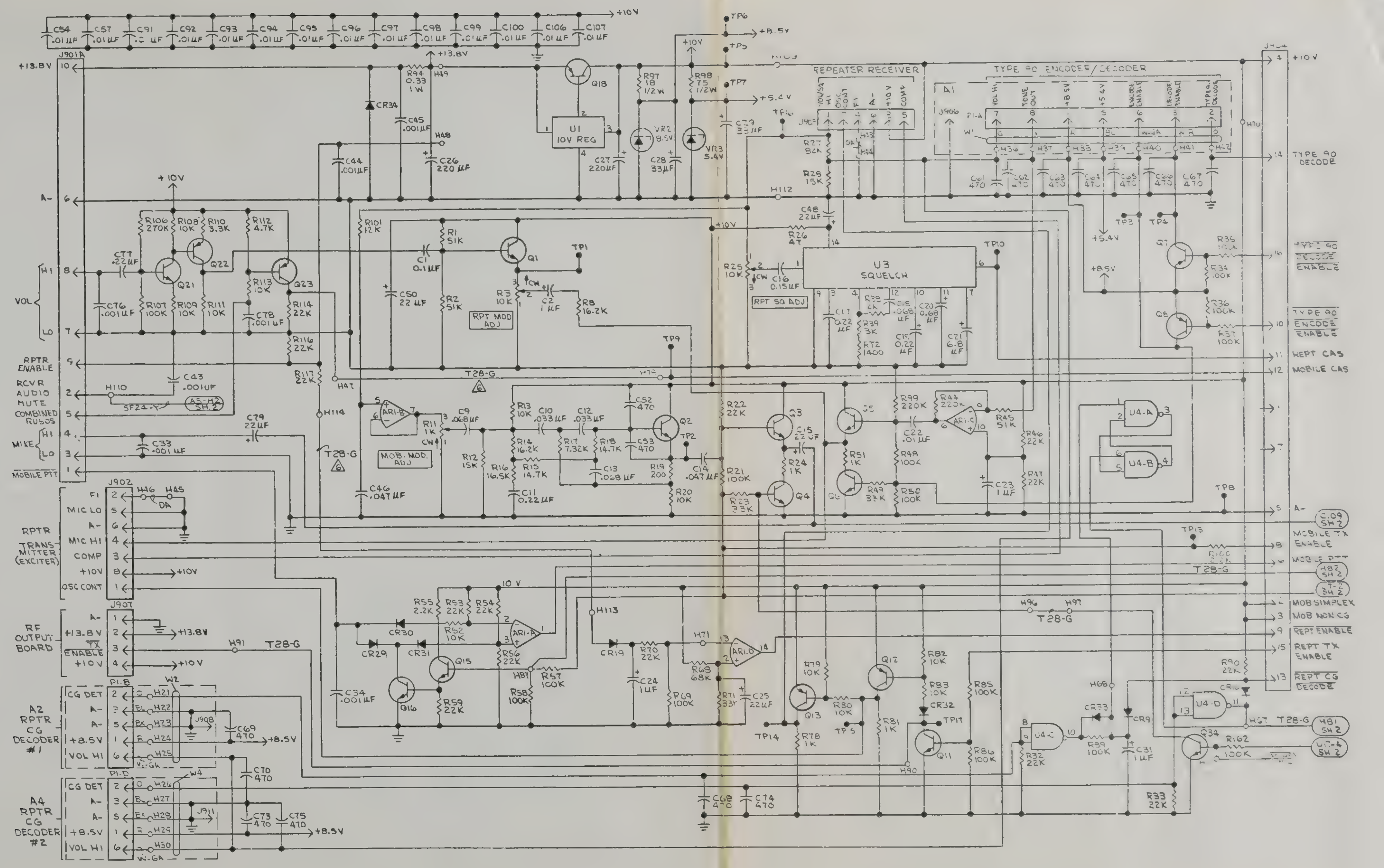
SYSTEM BOARD

PARTS LIST

RCVR AUDIO MUTE
19C331329G1

Issue 1

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - DIODES AND RECTIFIERS - - - - -
CR200	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
		- - - - - - - - - - - TRANSISTORS - - - - - - - - -
Q200	19A700022P1	Silicon, PNP; sim to Type 2N3906.
		- - - - - - - - - - - RESISTORS - - - - - - - - - -
R200	19A700106P91	Composition: 15K ohms ±5%, 1/4 w.
R201	3R152P224J	Composition: 220K ohms ±5%, 1/4 w.
R202	19A700106P103	Composition: 47K ohms ±5%, 1/4 w.
R203	19A700106P75	Composition: 3.3K ohms ±5%, 1/4 w.
		- - - - - - - - VOLTAGE REGULATORS - - - - - - - -
VR200	4036887P4	Zener: 500 mW, 4.4 v. nominal.



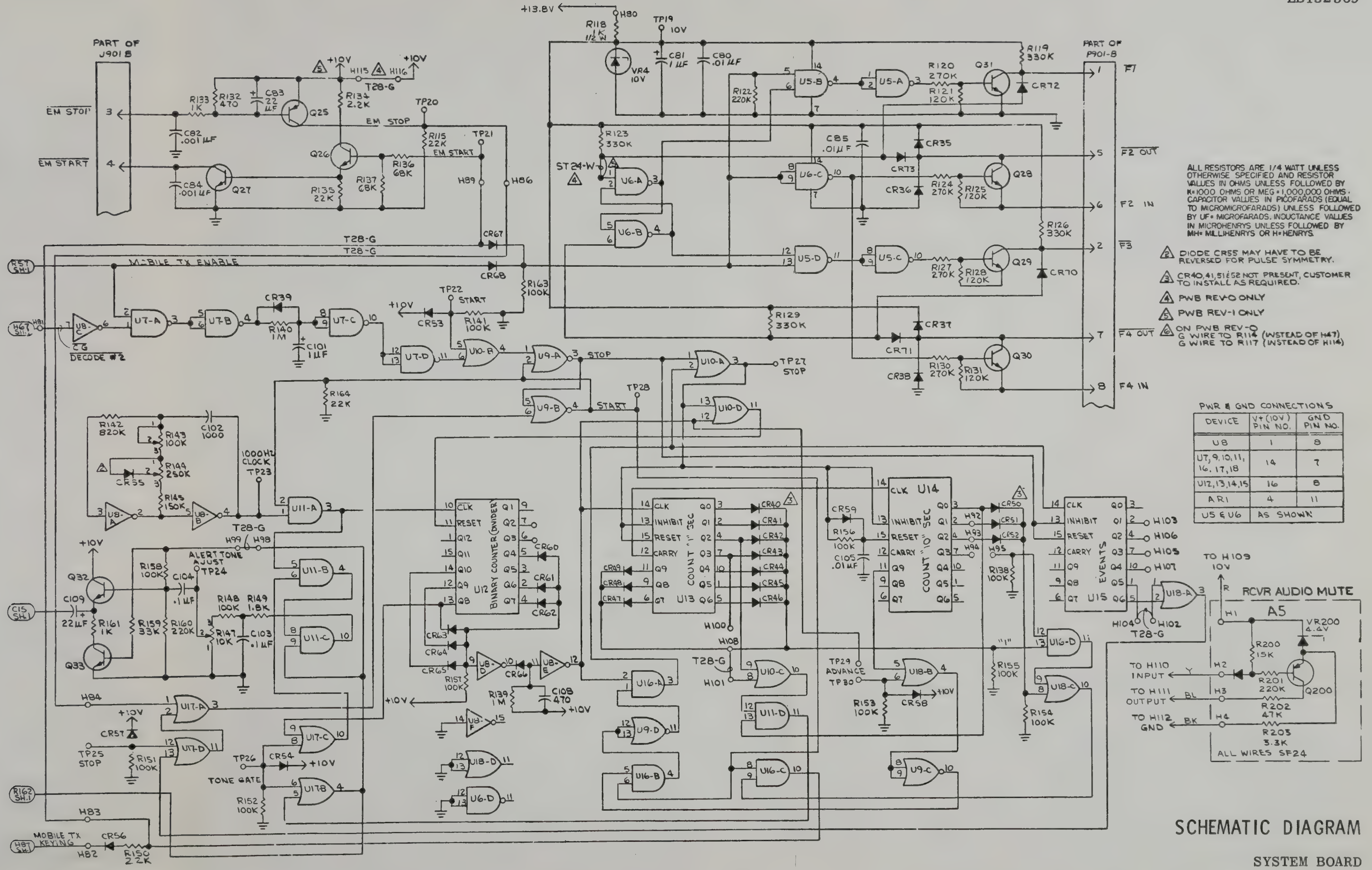
+10V
+13.8V
J901A
A-
VOL
HI
LO
RPTR ENABLE
RCVR AUDIO MUTE
COMBINED RUSOS
MIKE
MOBILE PTT
J902
FI
MIC LO
MIC HI
COMP
OSC CONT
RPTR TRANSMITTER (EXCITER)
J907
RF OUTPUT BOARD
TX ENABLE
P1-B
CG DET
+8.5V
VOL HI
A2 RPTR CG DECODER #1
P1-D
A4 RPTR CG DECODER #2
U1 10V REG
Q18
VR2 8.5V
VR3 5.4V
TP6
TP5
TP7
+8.5V
+5.4V
REPEATER RECEIVER
TYPE 90 ENCODER/DECODER
A1
U3 SQUELCH
RPT SQ ADJ
RPT MOD ADJ
MOB. MOD. ADJ
T28-G
Q1
Q2
Q3
Q4
Q21
Q22
Q23
AR1-A
AR1-B
AR1-C
AR1-D
U4-A
U4-B
U4-C
U4-D
Q7
Q8
Q11
Q12
Q13
Q15
Q16
Q34
TP1
TP2
TP8
TP9
TP10
TP13
TP14
TP17
TYPE 90 DECODE
TYPE 90 DECODE ENABLE
TYPE 90 ENCODE ENABLE
REPT CAS
MOBILE CAS
MOBILE TX ENABLE
MOBILE PTT
MOB SIMPLEX
MOB NON CG
REPT ENABLE
REPT TX ENABLE
REPT CG DECODE
SH 2

SCHEMATIC DIAGRAM

SYSTEM BOARD

Issue 3

(19D432684, Sh. 1, Rev. 5)



+13.8V
H80
R118 1K 1/2 W
VR4 10V
TP19 10V
C81 1 µF
C80 .01 µF
PART OF J901 B
EM STOP
EM START
+10V
H115
H116
T28-G
R133 1K
R132 470
C83 22 µF
Q25
R134 2.2K
TP20
EM STOP
R115 22K
TP21
C82 .001 µF
Q26
R136 68K
R137 68K
R135 22K
C84 .001 µF
Q27
H89
H86
CR67
CR68
R163 100K
MOBILE TX ENABLE
R57 SH.1
H67 SH.1
H81
U8-C
CG
DECODE #2
U7-A
U7-B
CR39
R140 1M
C101 1 µF
U7-C
U7-D
+10V
CR53
TP22 START
R141 100K
U10-B
U9-A
STOP
U9-B
START
TP28
U10-A
TP27 STOP
U10-D
R164 22K
R142 820K
R143 100K
C102 1000
R144 250K
CR55
R145 150K
U8-A
U8-B
1000HZ CLOCK TP23
U11-A
T28-G
H99
H98
U11-B
U11-C
+10V
Q32
R158 100K
ALERT TONE ADJUST TP24
C104 .1 µF
R148 100K
R149 1.8K
C15 SH.1
C109 22 µF
R161 1K
R159 33K
R160 220K
R147 10K
C103 .1 µF
Q33
H84
U17-A
+10V
CR57
TP25 STOP
R151 100K
U17-D
U17-C
TP26
CR54 +10V
TONE GATE
U17-B
R152 100K
R162 SH.1
H83
MOBILE TX KEYING
H87 SH.1
H82
CR56
R150 22K
U12 BINARY COUNTER (DIVIDER)
CLK
RESET
Q12
Q10
Q9
Q8
Q1
Q2
Q3
Q4
Q5
Q6
Q7
CR60
CR61
CR62
CR63
CR64
CR65
R157 100K
U8-D
CR66
U8-E
C108 470
+10V
R139 1M
U8-F
U18-D
U6-D
U13 COUNT "1" SEC
INHIBIT
CARRY
CR40
CR41
CR42
CR43
CR44
CR45
CR46
CR49
CR48
CR47
H100
H108
T28-G
H101
U16-A
U9-D
U16-B
U10-C
U11-D
U16-C
U14 COUNT "10" SEC
CR59
R156 100K
C105 .01 µF
TP29 ADVANCE
TP30
U18-B
CR58 +10V
R153 100K
U9-C
CR50
CR51
CR52
H92
H93
H94
H95
R138 100K
"1"
R155 100K
R154 100K
U15 EVENTS
U16-D
U18-C
U18-A
H103
H106
H105
H107
H104
H102
T28-G
TO H109 10V
RCVR AUDIO MUTE
A5
R
H1
VR200 4.4V
R200 15K
TO H110 INPUT
TO H111 OUTPUT
TO H112 GND
H2
H3
H4
Y
BL
BK
R201 220K
R202 47K
R203 3.3K
Q200
ALL WIRES SF24
R119 330K
PART OF P901-B
F1
F2 OUT
F2 IN
F3
F4 OUT
F4 IN
U5-B
U5-A
R120 270K
R121 120K
Q31
CR72
R122 220K
R123 330K
ST24-W
U6-A
U6-B
C85 .01 µF
CR35
CR73
U6-C
CR36
R124 270K
R125 120K
Q28
R126 330K
U5-D
U5-C
R127 270K
R128 120K
Q29
CR70
R129 330K
CR37
CR71
CR38
R130 270K
R131 120K
Q30

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- ⚠4 PWB REV-0 ONLY
- ⚠5 PWB REV-1 ONLY
- ⚠6 ON PWB REV-0
  G WIRE TO R114 (INSTEAD OF H47)
  G WIRE TO R117 (INSTEAD OF H114)

PWR & GND CONNECTIONS

DEVICE	V+ (10V) PIN NO.	GND PIN NO.
U8	1	8
U7, 9, 10, 11, 16, 17, 18	14	7
U12, 13, 14, 15	16	8
AR1	4	11
U5 & U6	AS SHOWN	

(19D432684, Sh. 2, Rev. 5)

SCHEMATIC DIAGRAM

SYSTEM BOARD

PARTS LIST

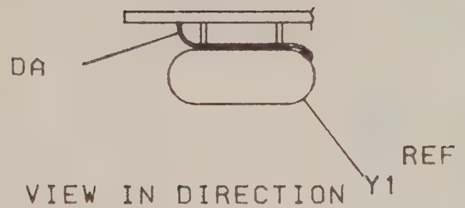
INTERFACE CABLE
19D430785G5

ISSUE 2

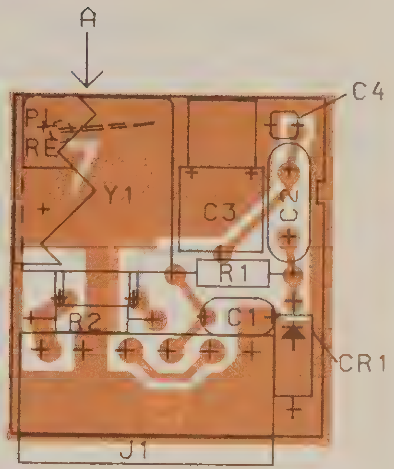
DESCRIPTION
- - - - - - - JACKS AND RECEPTACLES - - - - - - -
Connector. Includes:
Shell. (Reference Req. F206-2460).
Contact. VERNATRON P3-3352-4101-A16B. (J104-A & J104-B).
Contact. (J104-1 thru 5, 8 thru 17, 19 thru 23, 25 thru 34).
- - - - - - - - - - - CABLES - - - - - - - - -
CABLE ASSEMBLY 19D430786G5
- - - - - - - - - - - PLUGS - - - - - - - - - -
Connector. Includes:
Connector.
Cover. (Nut side).
Cover. (Screw side).
Thumbscrew.
Machine screw: No. 4-40 x 1-1/4. (Secures covers)
Nut, steel: No. 4-40. (Secures covers).
CABLE ASSEMBLY 19C330490G4
- - - - - - - - - - - PLUGS - - - - - - - - - -
Connector. Includes:
Connector block. (Reference Req. F206-2460).
Contact. VERNATRON S-3359-2001-A16B. (P104-A & P104-B).
Contact. (P104-1 thru 5, 8 thru 17, 19 thru 22, 25 thru 34).
Housing.
Cover.
Tap screw, Phillips POZIDRIV®: No. 7-19 x 1/2. (Quantity 2- Secures cover to housing).
Tap screw, Phillips POZIDRIV®: No. 8-18 x 3/4. (Quantity 1- Secures cover to housing).
- - - - - - - - - MISCELLANEOUS - - - - - - - -
Box. (Contains J104).
U Support. (Located at J104).
Cover. (Located over J104).
Tap screw, Phillips POZIDRIV®: No. 6-32 x 1/4. (Secures J104 cover).
Plate. (Used with J104- Reference Req. F206-2460).
Clamp. (Used with W8).
Clamp. (Used with W9).
Retainer strap; sim to Dennison Bar-Lok 08470. (Used with W8 & W9).
Cable loop. (Secures W9 in housing).
Splice nut.

TED OR CHANGED BY PRODUCTION CHANGES.

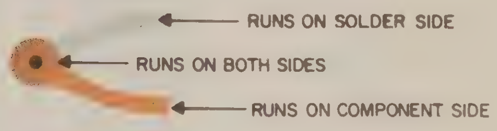
OUTLINE DIAGRAM



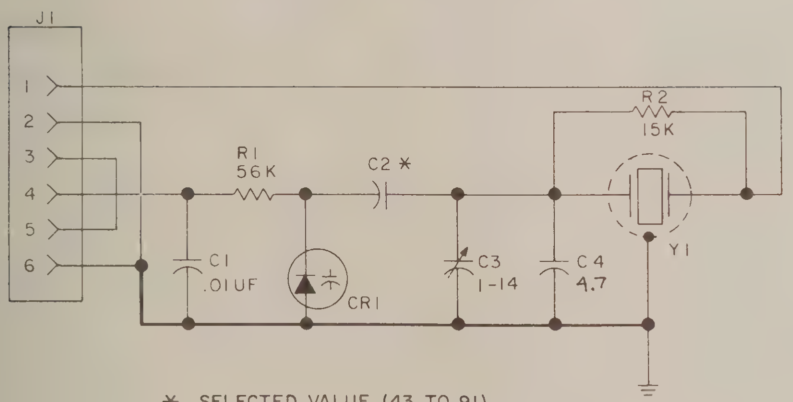
VIEW IN DIRECTION
OF ARROW "A"
(WITH SHIELD REMOVED)


A
C4
P1
REF
Y1
C3
C2
R1
R2
C1
CR1
J1

(19B227337, Rev. 6)
(19B226851, Sh. 1, Rev. 7)
(19B226851, Sh. 2, Rev. 6)


RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE

SCHEMATIC DIAGRAM


J1
1
2
3
4
5
6
R1
56K
C2 *
R2
15K
C1
.01UF
CR1
C3
1-14
C4
4.7
Y1

* SELECTED VALUE (43 TO 91)

MODEL NO	REV LETTER
PL19B226962G1-27	

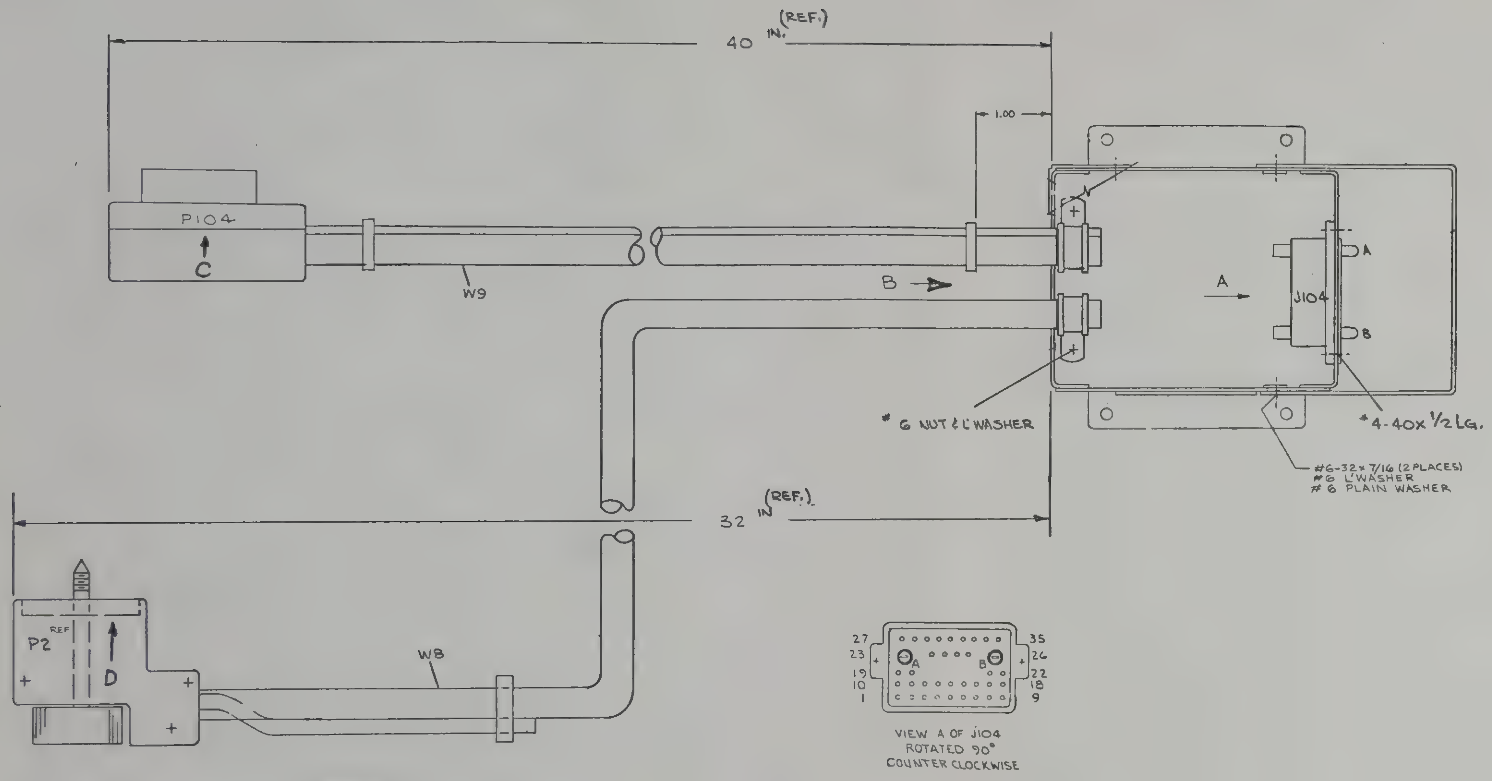
IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.

ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF=MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH=MILLIHENRYS OR H=HENRYS.

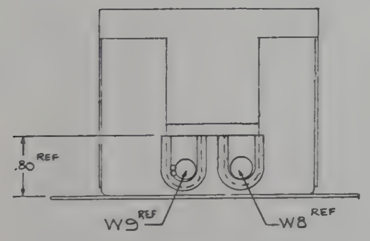
(19B226951, Rev. 5)

SCHEMATIC & OUTLINE DIAGRAM

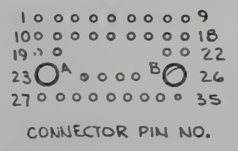
CRYSTAL MODULE


40 IN. (REF.)
1.00
P104
C
W9
B
A
J104
A
B
# 6 NUT & L'WASHER
*4-40x 1/2 LG.
#6-32 x 7/16 (2 PLACES)
#6 L'WASHER
#6 PLAIN WASHER
32 IN (REF.)
P2
REF
D
W8
27
23
19
10
1
35
26
22
18
9
A
B
VIEW A OF J104
ROTATED 90°
COUNTER CLOCKWISE

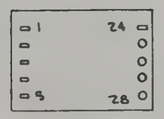
(19D430785, Sh. 6, Rev. 3)


.80 REF
W9 REF
W8 REF

VIEW-B
ROTATED 90° C'CLOCKWISE


1
9
10
18
19
22
23
A
B
26
27
35
CONNECTOR PIN NO.

VIEW 'C'



VIEW 'D'

OUTLINE DIAGRAM & PARTS LIST

INTERFACE CABLE

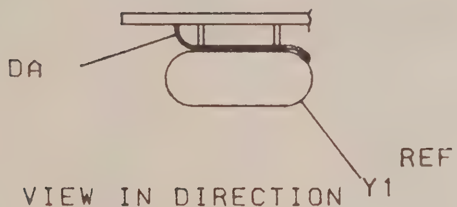
PARTS LIST

INTERFACE CABLE
19D430785G5

ISSUE 2

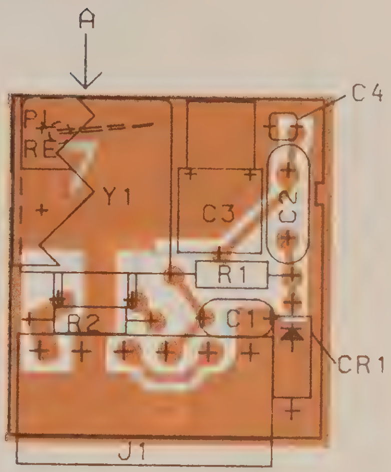
SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - JACKS AND RECEPTACLES - - - - - - -
J104		Connector. Includes:
	HS800918-1	Shell. (Reference Req. F206-2460). Contact. VERNATRON P3-3352-4101-A16B. (J104-A & J104-B).
	19A144001G2	Contact. (J104-1 thru 5, 8 thru 17, 19 thru 23, 25 thru 34).
		- - - - - - - - - - - CABLES - - - - - - - - -
W8		CABLE ASSEMBLY 19D430786G5
		- - - - - - - - - - - PLUGS - - - - - - - - - -
P2		Connector. Includes:
	19C311409P1	Connector.
	19D413039P1	Cover. (Nut side).
	19D413039P2	Cover. (Screw side).
	19C311411G1	Thumbscrew.
	N36P9020C6	Machine screw: No. 4-40 x 1-1/4. (Secures covers)
	N210P9C6	Nut, steel: No. 4-40. (Secures covers).
W9		CABLE ASSEMBLY 19C330490G4
		- - - - - - - - - - - PLUGS - - - - - - - - - -
P104		Connector. Includes:
	HS800918-2	Connector block. (Reference Req. F206-2460). Contact. VERNATRON S-3359-2001-A16B. (P104-A & P104-B).
	19A144001G1	Contact. (P104-1 thru 5, 8 thru 17, 19 thru 22, 25 thru 34).
	19A143956G1	Housing.
	19B233877P1	Cover.
	19A116773P108	Tap screw, Phillips POZIDRIV®: No. 7-19 x 1/2. (Quantity 2- Secures cover to housing).
	19A116773P212	Tap screw, Phillips POZIDRIV®: No. 8-18 x 3/4. (Quantity 1- Secures cover to housing).
		- - - - - - - - - MISCELLANEOUS - - - - - - - -
	19C331171G1	Box. (Contains J104).
	19A142959P1	U Support. (Located at J104).
	19B233459P3	Cover. (Located over J104).
	19B201074P304	Tap screw, Phillips POZIDRIV®: No. 6-32 x 1/4. (Secures J104 cover).
	HS801104-1	Plate. (Used with J104- Reference Req. F206-2460).
	5491480P6	Clamp. (Used with W8).
	5491480P8	Clamp. (Used with W9).
	19A115185P8	Retainer strap; sim to Dennison Bar-Lok 08470. (Used with W8 & W9).
	5491480P9	Cable loop. (Secures W9 in housing).
	19A115370P1	Splice nut.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.

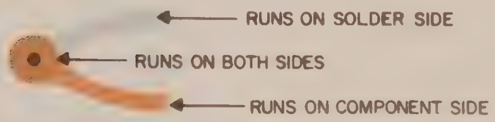


VIEW IN DIRECTION
OF ARROW "A"
(WITH SHIELD REMOVED)

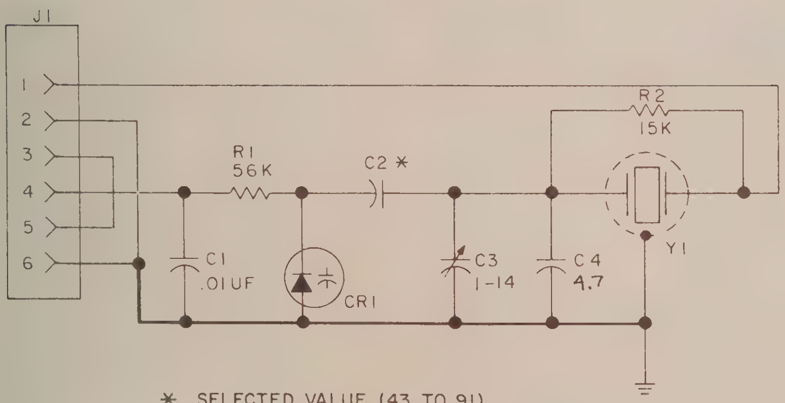
OUTLINE DIAGRAM


A
C4
P1
REF
Y1
C3
C2
R1
R2
C1
CR1
J1

(19B227337, Rev. 6)
(19B226851, Sh. 1, Rev. 7)
(19B226851, Sh. 2, Rev. 6)


RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE

SCHEMATIC DIAGRAM


J1
1
2
3
4
5
6
R1
56K
C2 *
R2
15K
C1
.01UF
CR1
C3
1-14
C4
4.7
Y1

MODEL NO	REV LETTER
PL19B226962G1-27	

✱ SELECTED VALUE (43 TO 91)

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(19B226951, Rev. 5)

SCHEMATIC & OUTLINE DIAGRAM

CRYSTAL MODULE

PARTS LIST

LBI30069E

CRYSTAL MODULE (5 PPM)
19B226962G1-G29, 31-34, 36

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - CRYSTAL MODULES - - - - - - - -
		NOTE: When reordering, give GE Part Number and specify exact transmitter or receiver frequency needed.
Y2601 thru Y2606		19B226962G1 Tx 29.7-36 MHz 19B226962G2 Tx 36-42 MHz 19B226962G3 Tx 42-50 MHz 19B226962G31 Tx 66-78 MHz 19B226962G32 Tx 77-88 MHz 19B226962G4 Tx 138-155 MHz 19B226962G5 Tx 150.8-174 MHz 19B226962G6 Tx 406-420 MHz 19B226962G28 Tx 420-450 MHz 19B226962G7 Tx 450-470 MHz 19B226962G8 Tx 470-494 MHz 19B226962G9 Tx 494-512 MHz 19B226962G10 Rx 29.7-36 MHz 19B226962G11 Rx 36-42 MHz 19B226962G12 Rx 42-50 MHz 19B226962G33 Rx 66-78 MHz 19B226962G34 Rx 77-88 MHz 19B226962G13 Rx 138-155 MHz 19B226962G14 Rx 150.8-174 MHz 19B226962G15 Rx 406-420 MHz 19B226962G29 Rx 420-450 MHz 19B226962G16 Rx 450-470 MHz 19B226962G17 Rx 470-494 MHz 19B226962G18 Rx 494-512 MHz 19B226962G19 Rx 138-155 MHz HIGH SIDE INJECT 19B226962G20 Rx 150.8-174 MHz HIGH SIDE INJECT 19B226962G21 Rx 406-420 MHz HIGH SIDE INJECT 19B226962G36 Rx 420-450 MHz HIGH SIDE INJECT 19B226962G22 Rx 450-470 MHz HIGH SIDE INJECT 19B226962G23 Rx 470-494 MHz HIGH SIDE INJECT 19B226962G24 Rx 494-512 MHz HIGH SIDE INJECT 19B226962G25 Rx 29.7-36 MHz ALTERNATE IF 19B226962G26 Rx 36-42 MHz ALTERNATE IF 19B226962G27 Rx 42-50 MHz ALTERNATE IF
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C2		Capacitor, compensating. (Factory selected to match crystal characteristics).
C3	19A134633P1	Variable, glass: 2 to 14 pf, 500 VDCW; sim to Sprague-Goodman GSG185A.
		- - - - - - - - - - CRYSTALS - - - - - - - - - -
Y1		Crystal. (Not Field replaceable).
		COMPONENT BOARD 19B226849G1
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C1	19A116080P101	Polyester: 0.01 µf ±10%, 50 VDCW.
C4		(Part of printed board 19B226850P1).
		- - - - - - - DIODES AND RECTIFIERS - - - - - - -
CR1	5495769P19	Silicon, variable capacitance, 34 pf nominal.
		- - - - - - - JACKS AND RECEPTACLES - - - - - - -
J1	19A116659P6	Connector, printed wiring: 6 contacts; sim to Molex 09-52-3061.
		- - - - - - - - - - RESISTORS - - - - - - - - -
R1	3R152P563J	Composition: 56K ohms ±5%, 1/4 w.
R2	3R152P153J	Composition: 15K ohms ±5%, 1/4 w.
		- - - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19B227397P1	Shield. (Y1).
	19A121175P39	Insulator, plate. (Used with C4).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

DESCRIPTION AND MAINTENANCE

VEHICULAR REPEATER LOGIC BOARD 19C328461

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SPECIFICATIONS

CARRIER CONTROLLED TIMER	2.0 ±.5 min.
TYPE 90 ENCODE TIMER	750 ±80 millisecond
TYPE 90 DECODE TIMER	1.0 ±0.5 sec.
DELAY STATE COUNTER	400 ±20 millisecond
PRIORITY INTERRUPT CLOCK	2.0 ±.3 sec.
PRIORITY INTERRUPT PULSE	6.0 ±.6 millisecond
OPERATING VOLTAGE	10.0 VDC regulated
CURRENT DRAIN	17 mA (Max.) @ 10 VDC

DESCRIPTION

The Logic Board is located in the Vehicular Repeater Unit and is used to control the various operational functions of the repeater and the mobile radio units.

The logic circuitry on the logic board will insure that only one Vehicular Repeater will be repeating within a portable radio coverage area.

If two Vehicular Repeaters should be repeating, the interference resulting from multiple repeater operation will automatically clear itself.

A Priority Interrupt circuit is provided so the operator of a remote portable PE radio unit can communicate to a base station via the Vehicular Repeater, by interrupting a Base-to-Mobile Transmission.

In reference to the logic board circuitry, a logic state "3" means the up/down counter will be in delay state "4". This logic state "3" is present on the logic board when no Vehicular Repeaters in the area are turned on. When the up/down counter on the logic board is in the delay state "0", the Vehicular Repeater is in a priority state.

The priority logic circuits assure that the last Vehicular Repeater System enabled will normally become the priority unit and will remain until another unit is enabled or the priority unit leaves the area.

If two Vehicular Repeater Systems are in the priority state "0" and have a direct communication path between them (i.e., the monitor receiver in each can receive the other's mobile radio transmission), one of the Vehicular Repeater Systems will move to delay state "1" and the other vehicular repeater will become the priority unit (state "0") to retransmit the radio communications.

During base-to-portable transmission, the vehicular repeater transmitter is unkeyed for 6 milliseconds every 2 seconds to check for portable radio transmissions. If there is activity on the portable frequency, the vehicular repeater will immediately cease transmitting (PORTABLE INTERRUPT). If there is a transmission with Channel Guard tone, the vehicular repeater immediately stops repeating base-to-portable and repeats portable-to-base. This turn around time can vary from 200 milliseconds to two seconds, depending on when the portable PE radio (PTT) was keyed. The Portable Interrupt clock allows the portable PE radio to seize priority when the Vehicular Repeater is repeating. If there is a transmission without Channel Guard tone, the vehicular repeater will immediately stop repeating.

If, for any reason, two or more vehicular repeaters are in the priority state, the first base-to-portable transmission longer than two seconds will cause all the vehicular repeaters in priority state, except one, to advance to delay state "1". This action is initiated by the portable interrupt function. On a base-to-portable transmission, each vehicular repeater is interrupted every two seconds to check for any portable transmission. Since the two second interval is generated by a free-running clock, the intervals in the priority units are random. All of the priority units, except the last one to interrupt will shut down. At the end of the base transmission, the interrupted repeaters will advance to delay state "1", clearing the system. This is known as MULTIPLE PRIORITY CLEARING.

ENABLE OF FIRST VEHICULAR REPEATER SYSTEM

When a vehicle containing the Vehicular Repeater System equipment arrives at a location that requires the operator to be away from the vehicle and yet maintain communication, the Vehicular Repeater System can be enabled. Normally, the portable PE radio should be inserted in the vehicular charger unit and the REPEATER switch be in the "on" position. The operator, removing the portable PE radio, automatically enables the Vehicular Repeater System. The mobile radio unit will transmit and receive on the Channel indicated on the Control Unit. The portable PE radio channel select switch should be set to the assigned repeater channel.

When the PE radio was initially removed from the vehicular charger unit, a switch closure in the vehicular charger unit caused a repeat enable signal to be applied to the logic circuitry in the vehicular repeater radio unit. This, in turn, causes the vehicular repeater transmitter to send a short burst (700 milliseconds) of Type 90 tone. Since no other Vehicular Repeater Systems have been enabled at this time the Type 90 tone burst has no effect. At the time of the Type 90 tone burst, the delay state counter in the enabled vehicular repeater is reset from delay state "3" to priority state "0", making this vehicular repeater the priority unit at this location.

ENABLE OF SECOND VEHICULAR REPEATER SYSTEM

When a second vehicle, having a Vehicular Repeater System, arrives in the general proximity of the first vehicle, nothing will happen until the repeater in the second vehicle is enabled. Upon removal of the portable PE radio and the automatic enabling of the Vehicular Repeater System, the second vehicular repeater transmitter sends a short burst (700 milliseconds) of Type 90 tone. This tone is received by the first vehicular repeater receiver and detected by its Type 90 decoder. The decoder output informs the logic and control circuits of the first vehicle that the second Vehicular Repeater System is assuming control and will become the priority vehicular repeater. The delay state counter in the first vehicular repeater will advance to delay state "1" while the delay state counter in the second vehicular repeater assumes the priority state. Transmissions to and from all portable PE radios in the area will now be repeated by the second Vehicular Repeater System.

ENABLE OF ADDITIONAL VEHICULAR REPEATER SYSTEMS

The arrival of additional vehicles with Vehicular Repeater Systems in the same general proximity of the last enabled priority vehicular repeater has no effect on the priority Vehicular Repeater System until the newly arrived Vehicular Repeater Systems are enabled. The delay state counter in each vehicular repeater insures that the last Vehicular Repeater System enabled will be the priority unit.

DEPARTURE OF VEHICULAR REPEATER SYSTEM VEHICLES

The order in which vehicular repeaters leave a location determines whether the priority changes. A vehicle that leaves or disables its Vehicular Repeater System and was not the priority unit has no effect on the remaining Vehicular Repeater Systems. Should the operator reinsert the portable PE radio into the vehicular charger unit of a priority Vehicular Repeater System thereby disabling the vehicular repeater, nothing will happen until a condition to repeat occurs. When this condition occurs, the remaining enabled Vehicular Repeater Systems begin to count down from their delay states. The first Vehicular Repeater System to reach delay state "0" becomes the priority unit and repeats, stopping the countdown in the remaining repeaters.

Refer to the Combination Manual for a complete system description of Vehicular Repeater operation.

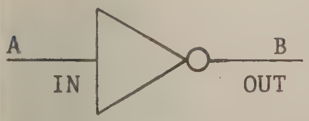
FUNDAMENTALS OF LOGIC CIRCUITS

A logic circuit is a device whose output is either high ("1") or low ("0"). No other condition can exist. By logical arrangement of these devices, functions are performed in a predetermined sequence.

Four main logic devices are used on the logic board in the vehicular repeater. A description of the logic devices and the corresponding "truth table" is provided. The "truth table" identifies all possible input combinations and the resulting output.

The presence of a circle on a logic symbol indicates the signal is inverted (a "1" would become a "0" and a "0" would become a "1").

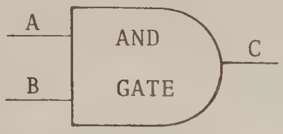
The inverter circuit produces an output which is the inverse of the input; a logic "1" at input (A) becomes a logic "0" at (B) and vice versa. Refer to the "truth table".



TRUTH TABLE

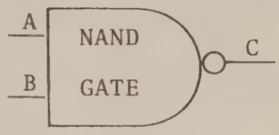
A	B
1	0
0	1

The AND GATE and OR GATE have two or more inputs. The output is determined by the logic level of the inputs. Refer to the "truth table". A circle on the output of an AND gate changes it to a NAND gate. A circle on the output of an OR gate changes it to a NOR gate. By definition:



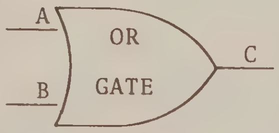
TRUTH TABLE

A	B	C
0	0	0
0	1	0
1	0	0
1	1	1



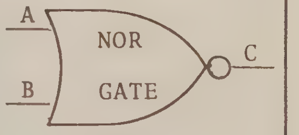
TRUTH TABLE

A	B	C
0	0	1
0	1	1
1	0	1
1	1	0



TRUTH TABLE

A	B	C
0	0	0
0	1	1
1	0	1
1	1	1



TRUTH TABLE

A	B	C
0	0	1
0	1	0
1	0	0
1	1	0

CAUTION

The CMOS Integrated Circuit devices used in this equipment can be destroyed by static discharges. Before handling one of these devices, the serviceman should discharge himself by touching the case of a bench test instrument that has a 3-prong power cord connected to an outlet with a known good earth ground. When soldering or de-soldering a CMOS device, the soldering iron should also have a 3-prong power cord connected to an outlet with a known good earth ground or a battery-operated soldering iron should be used.

CIRCUIT ANALYSIS

INPUT SIGNALS

Mobile Non-Channel Guard Indicator

This input is provided by the system board and tells the logic a given mobile radio channel will not have Channel Guard tones present. Therefore the logic will not look for Channel Guard on that channel before repeating. This is used in a multi-frequency radio where some RF channels have Channel Guard and some RF channels do not.

Channel Guard (CG) Decode

The CG Decoder provides a signal to tell the logic board that a Channel Guard tone from the mobile radio channel has been decoded.

Type 90 Decode

The Type 90 Decode input is received from the Type 90 Encode/Decode module. When present, it indicates that a Type 90 tone has been decoded on the repeater receiver or the repeater-to-portable channel.

The detected Type 90 tone burst received from other arriving vehicular repeaters, activates the Delay State Counter on the logic board in the repeaters already located in the coverage area.

Mobile Simplex Indicator

This input, provided by the System Board, indicates to the logic board that the mobile radio channel is either a simplex or half-duplex channel (separate transmit and receive frequencies). The logic looks for an input from the mobile detector.

Monitor CAS

The Monitor CAS input signal, provided by the optional mobile in the vehicular repeater detector, indicates whether activity is present on the mobile radio transmitter frequency, when operating not on a simplex channel. The logic board looks for a carrier transmitted via a mobile radio frequency.

Mobile CAS

The Mobile CAS input signal is provided by the squelch circuit located on the System Board in the vehicular repeater. It indicates when activity is present on the mobile radio channel as detected by the MASTR® II receiver. The logic looks for a carrier transmitted via the mobile radio frequency. It may be transmitted from a mobile or base station.

Mobile CG Decode

The Mobile CG Decode signal is received from the Mobile CG Decoder via the Systems board. When present, this signal indicates to the Logic Board that a properly tone coded message is being received from the base station or a second mobile radio.

Repeater CAS

The Repeater CAS input signal is received from the squelch circuit on the vehicular repeater system board. The logic looks for a carrier transmitted via a portable radio frequency which may be from a portable or from another repeater.

Repeater Channel Guard (CG) Decode

The Repeater CG Decode signal is received from the Channel Guard decoder located in the vehicular repeater. When present, this signal indicates to the logic that a portable radio Channel Guard tone has been decoded.

Mobile Push-To-Talk (PTT)

The PTT input signal received this input from the System Board and indicates that the mobile radio microphone (PTT) button has been pushed and that the mobile radio is in the transmit mode.

Repeater Enable

The Repeater Enable signal is provided by the vehicular charger unit. The vehicular charger unit is equipped with a REPEATER enable disable switch. When the REPEATER switch is placed in the ENABLED position and the portable PE radio is removed from the vehicular charger unit, a low is applied to the logic board, indicating the repeater is to be enabled.

OUTPUTS

Mobile Transmit Enable

The Mobile Transmit Enable signal is applied to the System Board in the vehicular repeater and causes the mobile radio transmitter to be keyed when the output lead is "high". This output is "high" when the vehicular repeater is repeating portable-to-base.

Type 90 Encode Enable

The Type 90 Encode Enable signal is applied to the Type 90 encode module that is plugged into the System Board in the vehicular repeater. When a repeat enable signal is applied to the logic circuitry, the vehicular repeater transmitter will send a short burst (700 milliseconds) of Type 90 tone. If no other Vehicular Repeater Systems have been enabled at this time the Type 90 tone burst has no effect. At the time of the Type 90 tone burst, the delay state counter in the enabled vehicular repeater is reset from delay state "3" to delay state "0" (Priority Unit).

Type 90 Decode Enable

The Type 90 Decode Enable signal is applied to the System Board in the vehicular repeater. When a second vehicular repeater arrives in the general proximity of the first (Priority) vehicular repeater and upon enabling the second vehicular repeater by removing the PE radio, the second vehicular repeater transmitter sends a short burst of Type 90 tone. This tone is received by the first vehicular repeater receiver and detected by its Type 90 Tone decoder. The decoder output informs the logic and control circuits of the first vehicle that the second Vehicular Repeater System is assuming control and will become the priority vehicular repeater.

Repeater Transmit Enable

The Repeater Transmit Enable signal causes the transmitter in the vehicular repeater to be keyed when the REPEAT TX ENABLE lead is high.

Repeat Condition Circuitry

The majority of the logic gates on the logic board are used to determine when a condition to repeat exists.

If a portable radio is transmitting, the output of NAND gate U8D-11 will be low.

If a base station or another mobile radio is transmitting, the NAND gate U8A-3 output will be low.

These two signals are fed to AND gate U6B whose output goes low anytime a portable radio transmission or a base station transmission occurs. This establishes a condition to repeat. The output of U6B-4 is fed to inverter U16A and U16B which are connected as a one-shot to generate a five-second delay state clock enable window.

The output of NOR gate U13B-4 goes high when another repeater is repeating base-to-portable.

The output of NOR gate U13C-10 goes high when another repeater is repeating portable-to-base.

The output of OR gate U2A-3 will go high whenever any other repeater is repeating. This signal is fed to the delay state clock U10A and U14A (when the condition to repeat exists and another repeater is repeating) to prevent it from causing the delay state counter to count down.

When conditions to repeat exists, the delay state clock in the non-priority vehicular repeater will begin to count down until another repeater is heard or until the unit becomes the priority unit.

If the vehicular repeater is in the quiescent state, the delay state counter is in delay state "4". The clock pulses are gated at U17-15 in order to count down the up/down counter. Each time the clock output inverter U14A-2 goes low (after the mobile radio or the portable carrier is detected) the up/down counter is stepped one increment.

If a repeat condition exists and all the vehicular repeaters are not in priority state, the delay state clock will look every 400 milliseconds to determine if another repeater is repeating. If no other repeater is repeating the delay state counter would then count down one state and the delay state clock would start to run again. This process will continue until the vehicular repeater that was in the lowest delay state would step down to the priority state and begin repeating.

When the condition to repeat exists, a correct portable or mobile radio signal will appear at AND gate U6B-4. This will cause the one-shot to be activated. The output of U16A is fed to inverter U9C and its output (high) is applied to OR gate U2B-6. If no other vehicular repeater is repeating a low will be applied to U2B-5. The output of U2B-4 will cause the delay state clock to count down one step.

Portable Interrupt Clock Circuit

The Portable Interrupt Clock Circuit consists of two inverters U15D and U15E connected as a free-running astable circuit with a 6 millisecond, 2 second unsymmetricial time period. The 6 millisecond period is applied to AND gate U5D-13 to interrupt base-to-portable transmission thus allowing for portable priority.

Multiple Priority Clearing Circuit

The Multiple Priority Clearing Circuit consists of NOR gate U12D and AND gate U11B. If two vehicular repeaters have assumed the priority state, on a base-to-portable transmission, the first unit to interrupt will stop repeating because the input to NOR gate U12A-2 will go high (from the repeater CAS). At the conclusion of the base-to-portable transmission, the Mobile CAS and Repeater CAS leads will go low at approximately the same time since the disabled priority repeater will be listening to both sides of the base-to-portable conversations. Since both inputs to U12D are low the output will go high, feeding a clock pulse through AND gate U11B and OR gate U3D to Delay State Counter U17. This clock pulse will count up from the priority state to delay state one.

Delay State Clock Circuit

The Delay State Clock Circuit consists of a four-input NOR gate U10A and an inverter U14A which are connected as an astable circuit with three disable leads ("PRIORITY" Pin 2, "MOBILE PTT" Pin 3 and "Repeater required" Pin 4). The clock is stopped whenever the delay state counter is in the zero (priority) state, when the mobile microphone PTT is activated or whenever a repeater is not required (Pin 4 is high). If any one of these inputs is high, the clock will be turned off. The clock is set via R13 for a 400 millisecond period, which is the length of each delay state.

Delay State Counter Circuit

The Delay State Counter Circuit consists of a four-bit, binary, presettable, resettable, up/down counter Integrated Circuit U17 and a four-input NOR gate U10B. U17 stores the delay state of the vehicular repeater. Whenever the vehicular repeater is in "delay state zero" (Q1, Q2, Q3 and Q4 are low), the output of NOR gate U10B is high indicating the priority state. The output of U10B is used to enable the logic circuitry to repeat when the proper condition exist.

Carrier Control Timer Circuit

The Carrier Control Timer Circuit consist of inverters U16E and U16F and are connected as a two minute monostable circuit. Refer to NOTE 1 of Schematic Diagram for determining the conditions to activate the CCT. The Carrier Control Timer (CCT) is activated by a negative pulse on the negative side of capacitor C22. When the monostable times out, OR gates U4A and U4B and NAND gate U9A preset the delay state counter to logic state four, removing the vehicular repeater from the priority state; thus the vehicular repeater will stop transmitting.

T90 Decode Timer/Window Delay

The T90 Decode Timer Circuit consists of OR gate U1C, timing network C9, R6, R7 and NOR gates U12C and U12B.

Whenever another vehicular repeater starts transmitting (a signal on the Repeater CAS input is received), the output of U1C-10 goes low charging capacitor C9 via R6 and providing a window delay of approximately 800 milliseconds. This window delay is low at U12C-8 and if U12C-9 is low (when REPEATER TX is disabled) a high will appear on the output U12C-10; thus U12B-4 will be low enabling the T90 DECODE lead for approximately 800 milliseconds.

T90 Decode Detector Circuit

The T90 Decode Detector Circuit consists of inverters U15C, U14F, OR gates U1D, U2C, U2D and U3D and NAND gate U8B.

If during the T90 decode time period, a T90 tone is detected on the T90 DECODE lead then its signal will be routed through the Decode Detector Circuit to provide a clock pulse on the output of U3D. This will advance the logic state of the up/down delay state counter U17 by one.

The T90 decode tone is fed to inverters U15C and U14F which form a hysterisis circuit. The output of U15C-6 will go low and is fed to OR gate U1D-13. With the output low at U1C-10 (when another repeater TX is keyed), Advance Delay State will go low on U1D-11 output. The lead going to inverter U7A is not used at this time. The output of OR gate U2C-10 will go low and when OR gate U2D-13 is low (not in state 8), the U2D-11 output will go low. NAND gate U8B-6 is high (since the delay state clock is not running) producing a high transition (delay state clock) on U8B-4 output. A high pulse will appear on up/down counter U17-15 and advance the state by one.

Mobile PTT and Repeater Enable Circuit

The Mobile PTT Circuit consists of NOR gate U13D and NAND gate U9A. If the vehicular repeater is disabled or the mobile radio is transmitting, the output of U13D-11 will be low causing U9A-3 to preset the delay state counter U17 to logic state four and keep it there until the mobile radio microphone PTT is released. This will insure that the vehicular repeater will not repeat.

When the mobile radio microphone PTT is released, the vehicular repeater will again be enabled but not repeating.

Mobile Transmitter Enable Circuit

The Mobile Transmitter Enable Circuit is active when a portable radio signal is being received as indicated by the inputs of NAND gate U8D. The output of U8D-11 will be low and this signal will be inverted by U15B and applied to AND gate U5C-8. If the delay state counter U10B is in the priority state, U5C-9 will be high and this will produce a high signal on the U5C-10 output to enable the mobile transmitter.

Repeater Transmitter Enable Circuit

If a mobile radio or base transmission is being received, the output of NAND gate U12A-3 will be high. This signal will be applied to AND gate U5B-5. If the delay state counter U10B is in the priority state, U5B-6 will be high thus producing a high at U5B-4. If the input to U5D-13 is high via the Portable Interrupt clock the signal will enable the Repeater Transmitter via OR gate U3A.

T90 Encode Timer Circuit

The T90 Encode Timer Circuit consists of inverters U7E, U7F, U14C and AND gate U11C.

When the vehicular repeater is first enabled, the output of AND gate U6C-10 goes low. This low enables the 700 millisecond monostable circuit of U7E and U7F which is applied to AND gate U11C. If another vehicular repeater is not repeating portable-to-base the output of U11C-10 will be high. This high is the T90 Encode signal and is inverted by U14C providing a low on T90 ENCODE ENABLE lead. OR gate U3A will enable the repeater transmitter at the same time.

Five-Second Window Circuit

The Five-Second Window Circuit consists of inverters U16A and U16B and provides a five-second window timer which is controlled by AND gate U6B. When a carrier is present on the REPEATER CAS lead or MOBILE CAS lead the five-second window circuit controls the window for the Type 90 decode signal, and also sets the window for the count down clock.

ADJUSTMENTS

The Logic Board has only one adjustment, the Delay State Clock. This is a factory adjustment, but may be adjusted in the field should the requirement arise.

DELAY STATE CLOCK

1. Apply a ground to test point TP9.
2. Connect an oscilloscope to test point TP4.
3. Adjust resistor R13 for a delay of 400 milliseconds.
4. Remove the oscilloscope and ground from the logic board test points.

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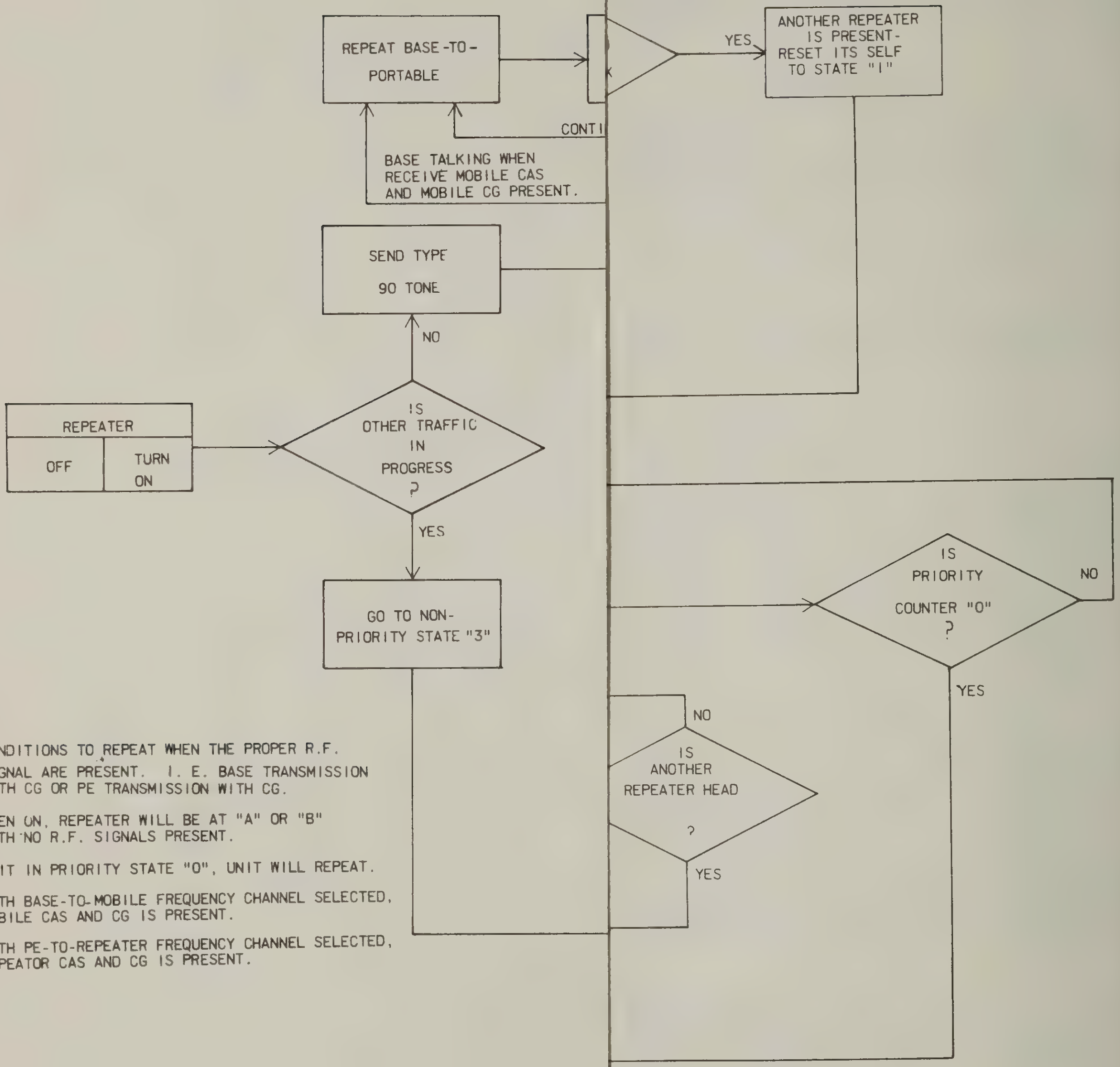

REPEAT BASE-TO-PORTABLE
ANOTHER REPEATER IS PRESENT-RESET ITS SELF TO STATE "1"
YES
CONTI
BASE TALKING WHEN RECEIVE MOBILE CAS AND MOBILE CG PRESENT.
SEND TYPE 90 TONE
NO
REPEATER
OFF
TURN ON
IS OTHER TRAFFIC IN PROGRESS ?
YES
GO TO NON-PRIORITY STATE "3"
IS PRIORITY COUNTER "0" ?
NO
YES
NO
IS ANOTHER REPEATER HEAD ?
YES

NOTE

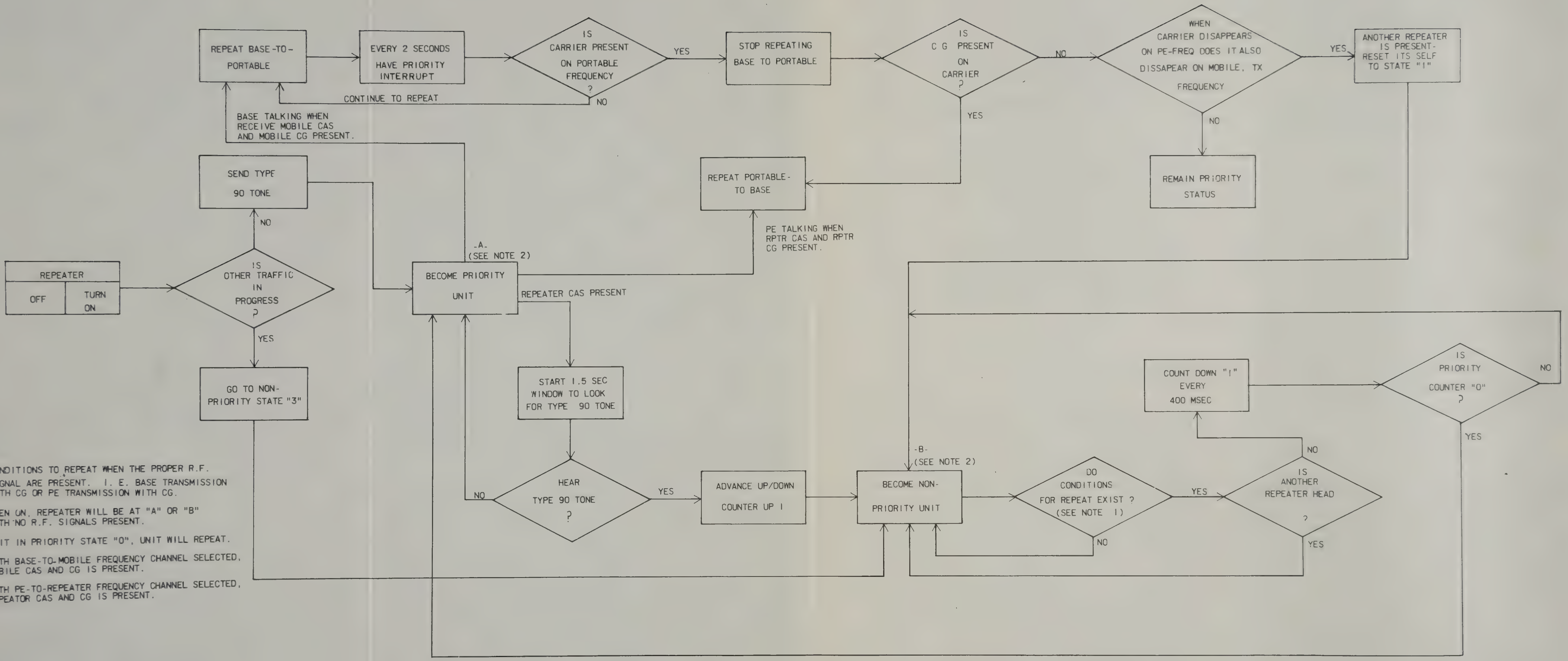
1. CONDITIONS TO REPEAT WHEN THE PROPER R.F. SIGNAL ARE PRESENT. I. E. BASE TRANSMISSION WITH CG OR PE TRANSMISSION WITH CG.
2. WHEN ON, REPEATER WILL BE AT "A" OR "B" WITH NO R.F. SIGNALS PRESENT.
3. UNIT IN PRIORITY STATE "0", UNIT WILL REPEAT.
4. WITH BASE-TO-MOBILE FREQUENCY CHANNEL SELECTED, MOBILE CAS AND CG IS PRESENT.
5. WITH PE-TO-REPEATER FREQUENCY CHANNEL SELECTED, REPEATOR CAS AND CG IS PRESENT.

FUNCTIONAL FLOW DIAGRAM

LOGIC BOARD

PROBLEM	CONDITION	POSSIBLE CAUSE
Repeater will not repeat Base-To-Portable	Repeater is "ON" and Enabled. Signal is present on mobile frequency	Check - Mobile CAS input Mobile CG input
Repeater won't repeat Portable-To-Base	Power turned "ON" Repeater is enabled	Check - Repeater CAS input Repeater CG decode input
Repeater TX will not transmit	Repeater is first enabled	Check - Type 90 Encode Timer for 700 ms, U3A
Repeater TX will not transmit	Type 90 Encoder was present on TP6 for 700 ms	Check - Delay State Counter, should be in priority state, U17
Repeater TX will not time out	Repeater is enabled portable or mobile is keyed longer than 2.5 min	Check - Carrier Control Timer, U16E, U16F
Type 90 Encoder Enable inoperative	Repeater first enabled	Check - Type 90 Encode Timer, U14C, U6C
Type 90 Decoder Enable inoperative	Repeater enabled and receiving a signal on Repeater CAS from a portable or another repeater	Check - Type 90 window delay circuit (C9, R6, R7), U1C, U8C, U12C
Mobile TX Enable inoperative	Signal received on Repeater CAS (P904-11) and Repeater CG (P904-13)	Check - U5C, U8D, U15B, U16C, U8C
Portable PE cannot interrupt a transmission from Base-To-Mobile	Repeater Transmitter not enabled	Check - Interrupt pulse every two seconds at TP5, U15D, U15E
Test point TP10 should be "high" (state 4), but TP10 is "low"	Repeater is disabled Mobile radio keyed CCT is "ON"	Check - U9A, U4B, U4A, U16E, U16F, U13D

TROUBLESHOOTING PROCEDURE


REPEAT BASE-TO-PORTABLE
EVERY 2 SECONDS HAVE PRIORITY INTERRUPT
IS CARRIER PRESENT ON PORTABLE FREQUENCY ?
YES
NO
CONTINUE TO REPEAT
STOP REPEATING BASE TO PORTABLE
IS C G PRESENT ON CARRIER ?
NO
YES
WHEN CARRIER DISAPPEARS ON PE-FREQ DOES IT ALSO DISSAPEAR ON MOBILE, TX FREQUENCY
YES
NO
ANOTHER REPEATER IS PRESENT-RESET ITS SELF TO STATE "1"
REMAIN PRIORITY STATUS
BASE TALKING WHEN RECEIVE MOBILE CAS AND MOBILE CG PRESENT.
REPEAT PORTABLE-TO BASE
PE TALKING WHEN RPTR CAS AND RPTR CG PRESENT.
SEND TYPE 90 TONE
NO
REPEATER
OFF
TURN ON
IS OTHER TRAFFIC IN PROGRESS ?
YES
-A-
(SEE NOTE 2)
BECOME PRIORITY UNIT
REPEATER CAS PRESENT
GO TO NON-PRIORITY STATE "3"
START 1.5 SEC WINDOW TO LOOK FOR TYPE 90 TONE
HEAR TYPE 90 TONE ?
NO
YES
ADVANCE UP/DOWN COUNTER UP 1
-B-
(SEE NOTE 2)
BECOME NON-PRIORITY UNIT
DO CONDITIONS FOR REPEAT EXIST ? (SEE NOTE 1)
YES
NO
IS ANOTHER REPEATER HEAD ?
NO
YES
COUNT DOWN "1" EVERY 400 MSEC
IS PRIORITY COUNTER "0" ?
NO
YES

NOTE

1. CONDITIONS TO REPEAT WHEN THE PROPER R.F. SIGNAL ARE PRESENT. I. E. BASE TRANSMISSION WITH CG OR PE TRANSMISSION WITH CG.
2. WHEN ON, REPEATER WILL BE AT "A" OR "B" WITH NO R.F. SIGNALS PRESENT.
3. UNIT IN PRIORITY STATE "0", UNIT WILL REPEAT.
4. WITH BASE-TO-MOBILE FREQUENCY CHANNEL SELECTED, MOBILE CAS AND CG IS PRESENT.
5. WITH PE-TO-REPEATER FREQUENCY CHANNEL SELECTED, REPEATOR CAS AND CG IS PRESENT.

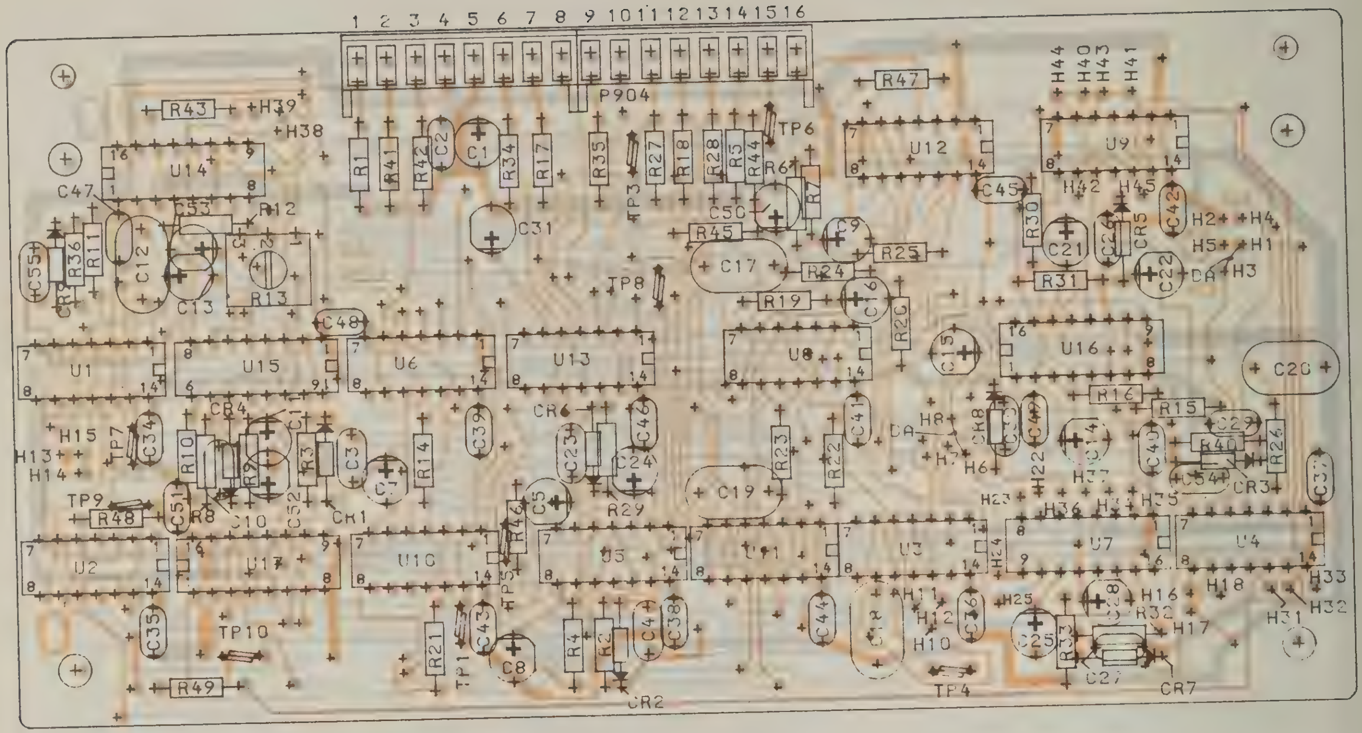
RC3876

FUNCTIONAL FLOW DIAGRAM

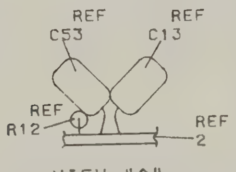
LOGIC BOARD

PROBLEM	CONDITION	POSSIBLE CAUSE
Repeater will not repeat Base-To-Portable	Repeater is "ON" and Enabled. Signal is present on mobile frequency	Check - Mobile CAS input Mobile CG input
Repeater won't repeat Portable-To-Base	Power turned "ON" Repeater is enabled	Check - Repeater CAS input Repeater CG decode input
Repeater TX will not transmit	Repeater is first enabled	Check - Type 90 Encode Timer for 700 ms, U3A
Repeater TX will not transmit	Type 90 Encoder was present on TP6 for 700 ms	Check - Delay State Counter, should be in priority state, U17
Repeater TX will not time out	Repeater is enabled portable or mobile is keyed longer than 2.5 min	Check - Carrier Control Timer, U16E, U16F
Type 90 Encoder Enable inoperative	Repeater first enabled	Check - Type 90 Encode Timer, U14C, U6C
Type 90 Decoder Enable inoperative	Repeater enabled and receiving a signal on Repeater CAS from a portable or another repeater	Check - Type 90 window delay circuit (C9, R6, R7), U1C, U8C, U12C
Mobile TX Enable inoperative	Signal received on Repeater CAS (P904-11) and Repeater CG (P904-13)	Check - U5C, U8D, U15B, U16C, U8C
Portable PE cannot interrupt a transmission from Base-To-Mobile	Repeater Transmitter not enabled	Check - Interrupt pulse every two seconds at TP5, U15D, U15E
Test point TP10 should be "high" (state 4), but TP10 is "low"	Repeater is disabled Mobile radio keyed CCT is "ON"	Check - U9A, U4B, U4A, U16E, U16F, U13D

TROUBLESHOOTING PROCEDURE


1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
P904
R43
H39
H38
U14
C47
C53
R12
C55
R36
R11
C12
C13
R13
R1
R41
R42
C2
C1
R34
R17
C31
R35
TP3
R27
R18
R28
R5
R44
TP6
R6
R7
C50
R45
C17
R24
TP8
R19
C9
R25
C16
R20
R47
U12
C45
H44
H40
H43
H41
U9
H42
H45
R30
C21
C26
CR5
C42
H2
H4
H5
H1
H3
DA
R31
C22
C48
U1
U15
U6
U13
U8
U16
C15
C20
R16
R15
C29
R40
R26
C54
CR3
C37
H15
H13
H14
TP7
C34
R10
CR4
C11
R9
R3
C3
C7
R14
C39
CR6
C23
C46
C24
R29
C19
R23
R22
C41
DA
H8
CR8
C47
C14
H7
H6
R22
H36
H35
H23
C40
TP9
R48
C51
R8
C10
C52
CR1
C5
R46
U2
U17
U10
U5
U11
U3
H24
U7
U4
H33
H32
H31
H18
H16
H17
R32
TP5
TP10
R21
TP1
C43
C8
R4
R2
C4
C38
C44
C18
C36
H11
H12
H10
H25
C25
R33
C28
C27
CR7
TP4
CR2
R49

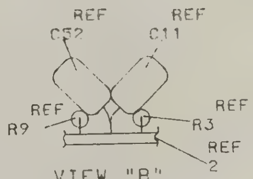
(19C328462, Rev. 0)
(19A138268, Sh. 1, Rev. 0)
(19A138268, Sh. 2, Rev. 0)


REF
C53
REF
C13
REF
R12
REF
2

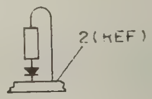
VIEW "A"
ROTATED 90 DEG. CCW
TYP. LEAD FORMING FOR
C53 & C13

CONNECTION CHART		
FROM	TO	WIRE
H34	H35	ST22W
H36	H37	ST22W
H38	H39	ST22W
H40	H41	ST22W

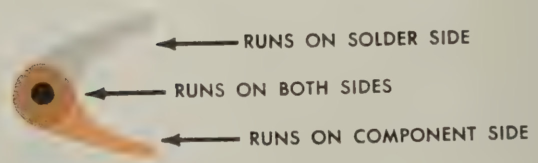
SEE WIRING DIAGRAM FOR DA JUMPERS.


REF
C52
REF
C11
REF
R9
REF
R3
REF
2

VIEW "B"
TYP. LEAD FORMING FOR
C52 & C11

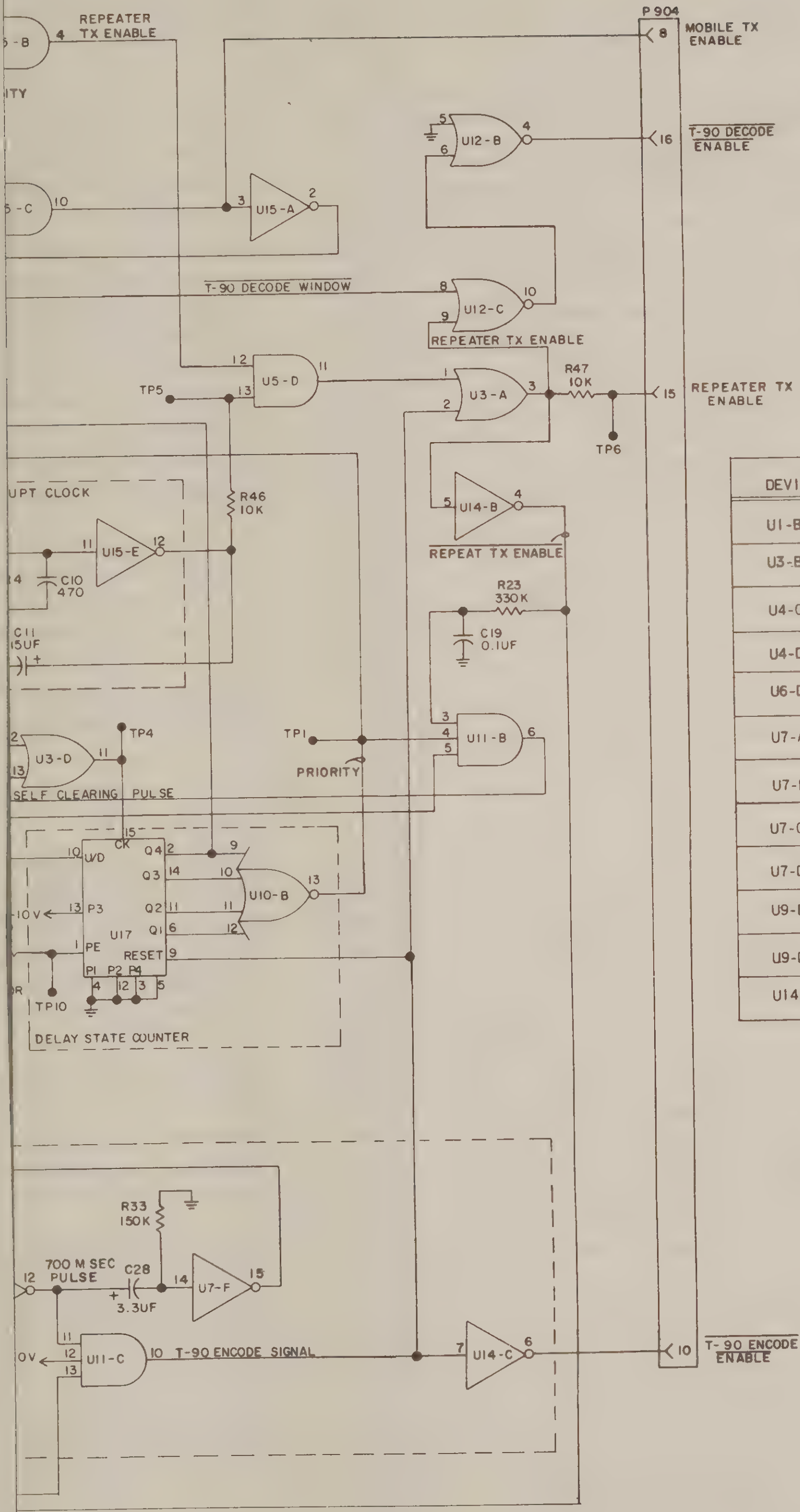


POLARITY FOR
CR10


RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE

OUTLINE DIAGRAM

LOGIC BOARD 19C328461


REPEATER TX ENABLE
P904
MOBILE TX ENABLE
T-90 DECODE ENABLE
U12-B
U15-A
T-90 DECODE WINDOW
U12-C
REPEATER TX ENABLE
U5-D
U3-A
R47 10K
REPEATER TX ENABLE
TP5
TP6
U14-B
REPEAT TX ENABLE
R46 10K
UPT CLOCK
U15-E
C10 470
C11 15UF
R23 330K
C19 0.1UF
U3-D
TP4
TP1
PRIORITY
U11-B
SELF CLEARING PULSE
U17
U10-B
-10V
TP10
DELAY STATE COUNTER
R33 150K
700 M SEC PULSE
C28 3.3UF
U7-F
U11-C
T-90 ENCODE SIGNAL
U14-C
T-90 ENCODE ENABLE

MODEL NO	REV LETTER
PL19C328461G1	

ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF=MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH=MILLIHENRYS OR H=HENRYS.

SPARE GATES

DEVICE	INPUT (GND)	OUTPUT
U1-B	H13 (PIN 5) H14 (PIN 6)	H15 (PIN 4)
U3-B	H11 (PIN 5) H10 (PIN 6)	H12 (PIN 4)
U4-C	H16 (PIN 8) H17 (PIN 9)	H18 (PIN 18)
U4-D	H32 (PIN 12) H33 (PIN 13)	H31 (PIN 11)
U6-D	H19 (PIN 12) H20 (PIN 13)	H21 (PIN 11)
U7-A	H34 (PIN 3)	H35 (PIN 2)
U7-B	H36 (PIN 5)	H37 (PIN 4)
U7-C	H23 (PIN 7)	H22 (PIN 6)
U7-D	H24 (PIN 9)	H25 (PIN 10)
U9-B	H43 (PIN 5) H44 (PIN 6)	H45 (PIN 4)
U9-D	H40 (PIN 12) H41 (PIN 13)	H42 (PIN 11)
U14-D	H38 (PIN 9)	H39 (PIN 10)

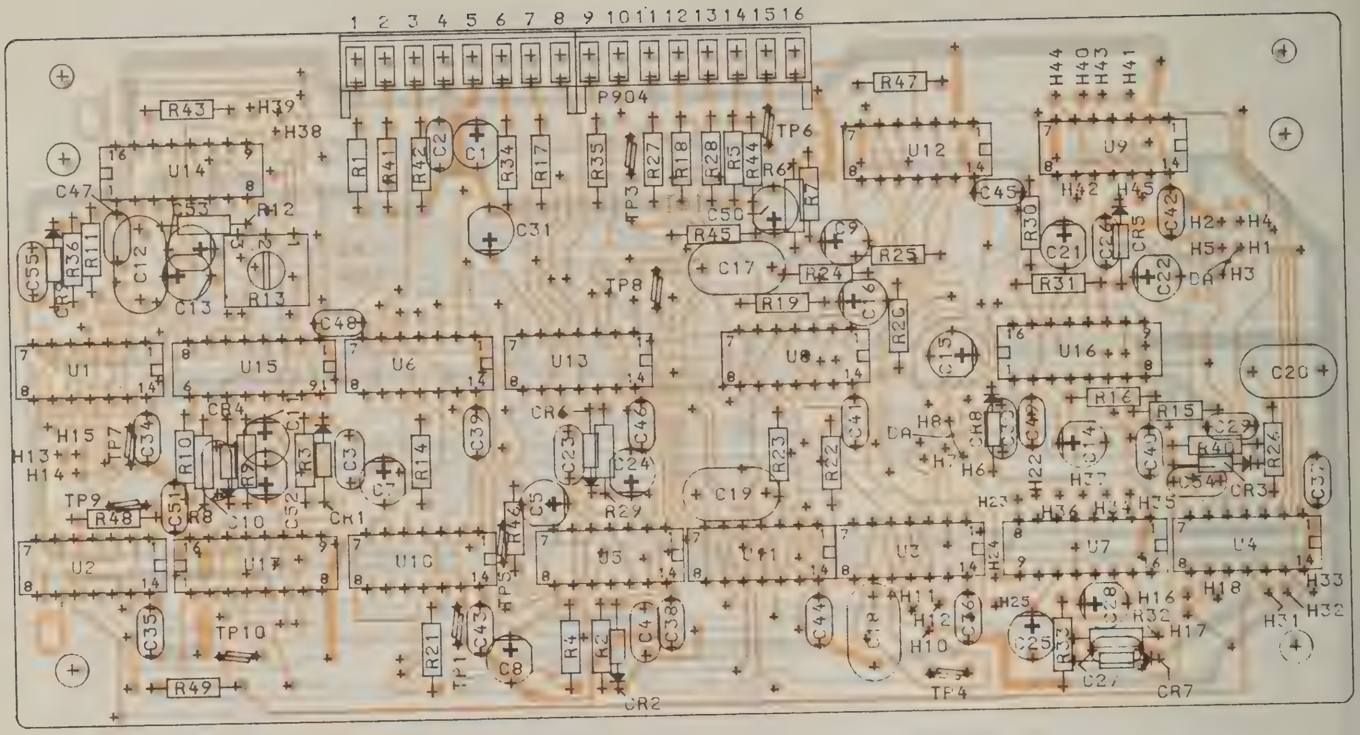
E-TO-PORTABLE OR PORTABLE-TO-BASE REPEAT PATH.
D-PORTABLE REPEAT PATH ONLY.
LE-TO BASE REPEAT PATH ONLY.

R REPEATER IS REPEATING PORTABLE-TO-BASE.
IS ANY ACTIVITY ON THE PORTABLE FREQUENCY.

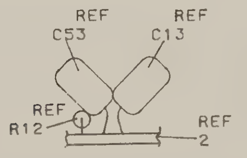
SCHEMATIC DIAGRAM

LOGIC BOARD 19C328461G1

Issue 1


1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
P904
R43
H39
H38
U14
C47
C53
R12
R13
C55
R36
R11
C12
C13
CR9
R1
R41
R42
C2
C1
R34
R17
C31
R35
TP3
R27
R18
R28
R5
R44
TP6
R6
R7
C50
R45
C17
R24
TP8
R19
C9
R25
C16
R20
R47
U12
C45
U9
H44
H40
H43
H41
H42
H45
R30
C21
C26
CR5
C42
C22
R31
H2
H4
H5
H1
H3
DA
C48
U1
U15
U6
U13
U8
C15
U16
C20
CR4
H15
H13
H14
TP7
C34
R10
R9
C11
R3
C3
C7
R14
C39
CR6
C23
C46
C24
R23
R22
C41
DA
H8
H7
H6
CR8
C33
C49
C14
R16
R15
C29
R40
C40
C54
R26
CR3
C37
TP9
R48
C51
R8
C10
C52
CR1
C5
R29
C19
H22
H37
H23
H36
H34
H35
U2
U17
U10
R46
TP5
U5
U11
U3
H24
U7
U4
C35
TP10
R21
TP1
C43
C8
R4
R2
C4
C38
C44
C18
H11
H12
H10
C36
H25
C28
H16
R32
H17
H18
H33
H32
H31
C25
R33
C27
CR7
TP4
CR2
R49

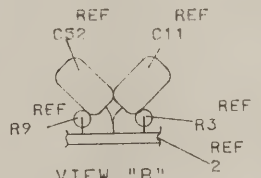
(19C328462, Rev. 0)
(19A138268, Sh. 1, Rev. 0)
(19A138268, Sh. 2, Rev. 0)


REF
C53
REF
C13
REF
R12
REF
2

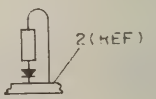
VIEW "A"
ROTATED 90 DEG. CCW
TYP. LEAD FORMING FOR
C53 & C13

CONNECTION CHART		
FROM	TO	WIRE
H34	H35	ST22W
H36	H37	ST22W
H38	H39	ST22W
H40	H41	ST22W

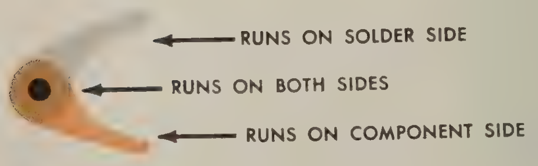
SEE WIRING DIAGRAM FOR DA JUMPERS.


REF
C52
REF
C11
REF
R9
REF
R3
REF
2

VIEW "B"
TYP. LEAD FORMING FOR
C52 & C11

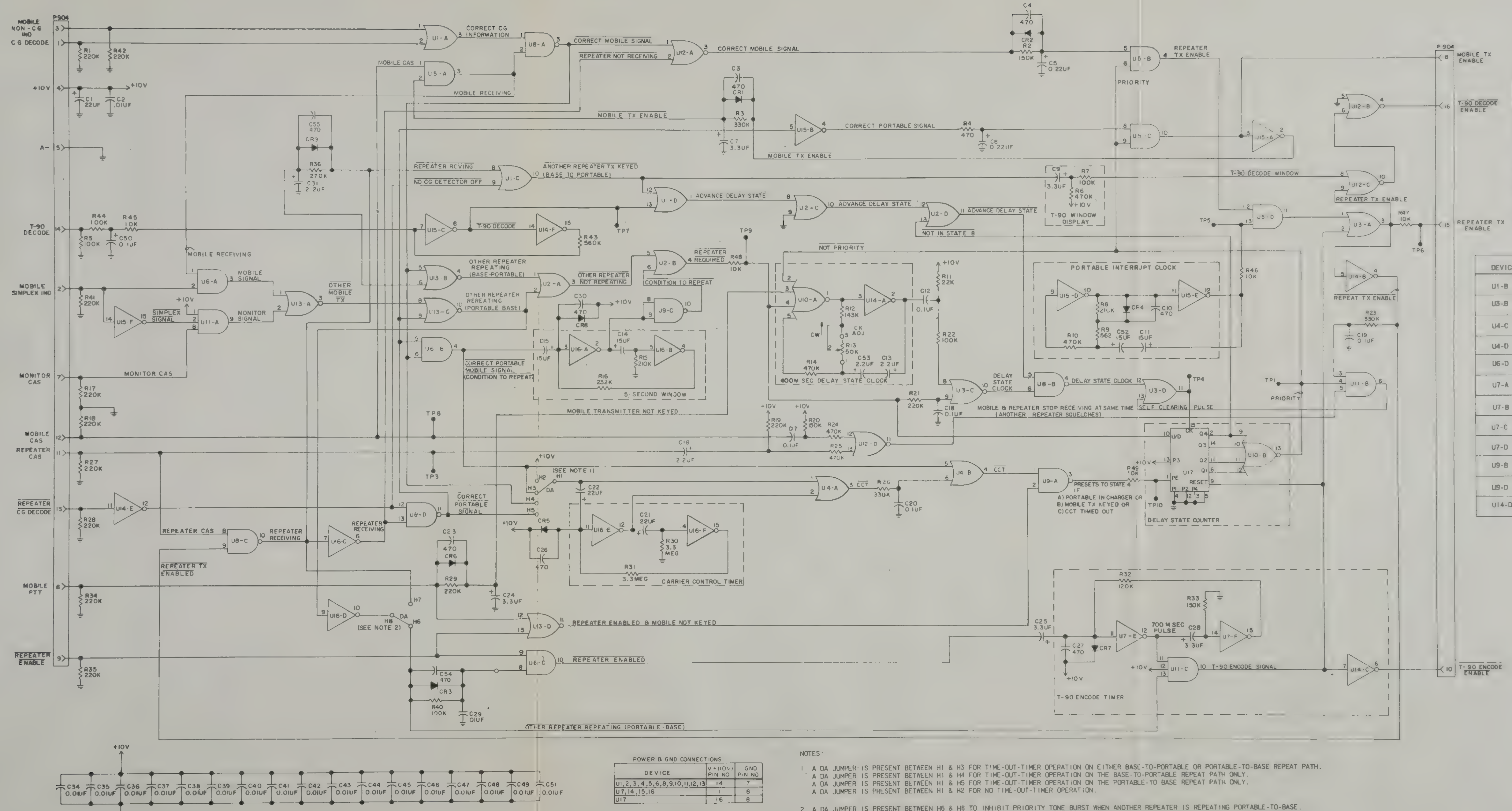


POLARITY FOR
CR10


RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE

OUTLINE DIAGRAM

LOGIC BOARD 19C328461


P904
MOBILE NON-CG IND
CG DECODE
+10V
A-
T-90 DECODE
MOBILE SIMPLEX IND
MONITOR CAS
MOBILE CAS
REPEATER CAS
REPEATER CG DECODE
MOBILE PTT
REPEATER ENABLE
CORRECT CG INFORMATION
CORRECT MOBILE SIGNAL
REPEATER NOT RECEIVING
MOBILE CAS
MOBILE RECEIVING
MOBILE TX ENABLE
CORRECT PORTABLE SIGNAL
REPEATER RCVING
NO CG DETECTOR OFF
ANOTHER REPEATER TX KEYED (BASE TO PORTABLE)
ADVANCE DELAY STATE
T-90 DECODE
OTHER REPEATER REPEATING (BASE-PORTABLE)
OTHER REPEATER REREATING (PORTABLE BASE)
OTHER REPEATER NOT REPEATING
REPEATER REQUIRED
CONDITION TO REPEAT
MOBILE SIGNAL
MONITOR SIGNAL
SIMPLEX SIGNAL
OTHER MOBILE TX
NOT PRIORITY
NOT IN STATE 8
400M SEC DELAY STATE CLOCK
CK ADJ
CW
PORTABLE INTERRUPT CLOCK
DELAY STATE CLOCK
SELF CLEARING PULSE
DELAY STATE COUNTER
MOBILE & REPEATER STOP RECEIVING AT SAME TIME (ANOTHER REPEATER SQUELCHES)
CORRECT PORTABLE MOBILE SIGNAL (CONDITION TO REPEAT)
5-SECOND WINDOW
MOBILE TRANSMITTER NOT KEYED
(SEE NOTE 1)
(SEE NOTE 2)
CCT
PRESETS TO STATE 4 IF A) PORTABLE IN CHARGER OR B) MOBILE TX KEYED OR C) CCT TIMED OUT
CARRIER CONTROL TIMER
REPEATER RECEIVING
REPEATER TX ENABLED
REPEATER ENABLED & MOBILE NOT KEYED
REPEATER ENABLED
OTHER REPEATER REPEATING (PORTABLE-BASE)
700 M SEC PULSE
T-90 ENCODE SIGNAL
T-90 ENCODE TIMER
REPEATER TX ENABLE
PRIORITY
T-90 WINDOW DISPLAY
T-90 DECODE WINDOW
REPEAT TX ENABLE
MOBILE TX ENABLE
T-90 DECODE ENABLE
REPEATER TX ENABLE
T-90 ENCODE ENABLE
TP1
TP3
TP4
TP5
TP6
TP7
TP8
TP9
TP10
C34 0.01UF
C35 0.01UF
C36 0.01UF
C37 0.01UF
C38 0.01UF
C39 0.01UF
C40 0.01UF
C41 0.01UF
C42 0.01UF
C43 0.01UF
C44 0.01UF
C45 0.01UF
C46 0.01UF
C47 0.01UF
C48 0.01UF
C49 0.01UF
C51 0.01UF

MODEL NO	REV LETTER
PL19C328461G1	

ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.

SPARE GATES

DEVICE	INPUT (GND)	OUTPUT
U1-B	H13 (PIN 5) H14 (PIN 6)	H15 (PIN 4)
U3-B	H11 (PIN 5) H10 (PIN 6)	H12 (PIN 4)
U4-C	H16 (PIN 8) H17 (PIN 9)	H18 (PIN 18)
U4-D	H32 (PIN 12) H33 (PIN 13)	H31 (PIN 11)
U6-D	H19 (PIN 12) H20 (PIN 13)	H21 (PIN 11)
U7-A	H34 (PIN 3)	H35 (PIN 2)
U7-B	H36 (PIN 5)	H37 (PIN 4)
U7-C	H23 (PIN 7)	H22 (PIN 6)
U7-D	H24 (PIN 9)	H25 (PIN 10)
U9-B	H43 (PIN 5) H44 (PIN 6)	H45 (PIN 4)
U9-D	H40 (PIN 12) H41 (PIN 13)	H42 (PIN 11)
U14-D	H38 (PIN 9)	H39 (PIN 10)

POWER & GND CONNECTIONS

DEVICE	V+(10V) PIN NO	GND PIN NO
U1,2,3,4,5,6,8,9,10,11,12,13	14	7
U7,14,15,16	1	8
U17	16	8

(19E501747, Rev. 1)

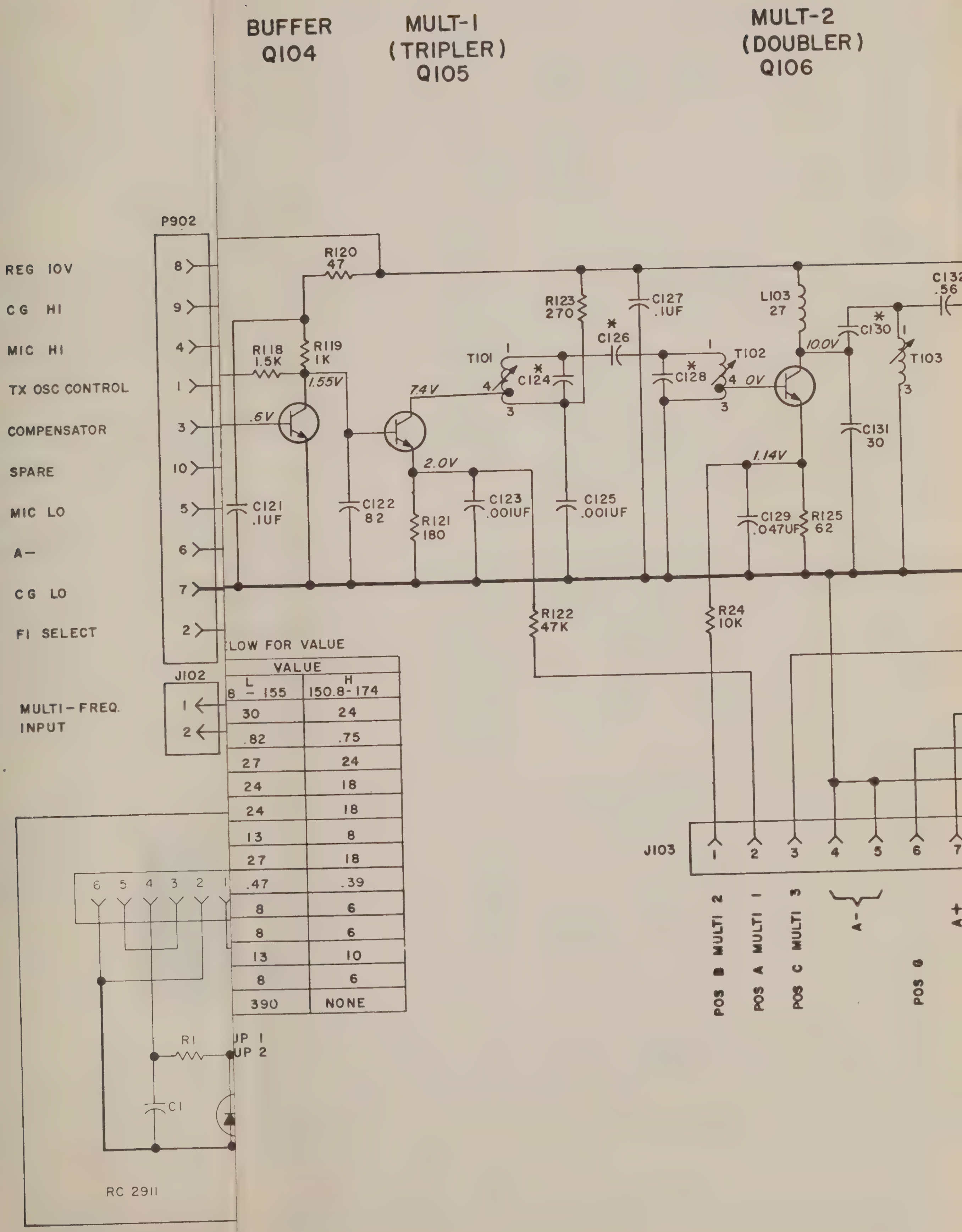
NOTES:

1. A DA JUMPER IS PRESENT BETWEEN H1 & H3 FOR TIME-OUT-TIMER OPERATION ON EITHER BASE-TO-PORTABLE OR PORTABLE-TO-BASE REPEAT PATH.
   A DA JUMPER IS PRESENT BETWEEN H1 & H4 FOR TIME-OUT-TIMER OPERATION ON THE BASE-TO-PORTABLE REPEAT PATH ONLY.
   A DA JUMPER IS PRESENT BETWEEN H1 & H5 FOR TIME-OUT-TIMER OPERATION ON THE PORTABLE-TO BASE REPEAT PATH ONLY.
   A DA JUMPER IS PRESENT BETWEEN H1 & H2 FOR NO TIME-OUT-TIMER OPERATION.
2. A DA JUMPER IS PRESENT BETWEEN H6 & H8 TO INHIBIT PRIORITY TONE BURST WHEN ANOTHER REPEATER IS REPEATING PORTABLE-TO-BASE.
   A DA JUMPER IS PRESENT BETWEEN H6 & H7 TO INHIBIT PRIORITY TONE BURST WHEN THERE IS ANY ACTIVITY ON THE PORTABLE FREQUENCY.
3. A CONDITION WITH THE BAR INDICATES A LOGIC "0" IS PRESENT.
4. A CONDITION WITHOUT THE BAR INDICATES A LOGIC "1" IS PRESENT.

SCHEMATIC DIAGRAM

LOGIC BOARD 19C328461G1

Issue 1


BUFFER
Q104
MULT-1
(TRIPLER)
Q105
MULT-2
(DOUBLER)
Q106
P902
REG 10V
CG HI
MIC HI
TX OSC CONTROL
COMPENSATOR
SPARE
MIC LO
A-
CG LO
FI SELECT
8
9
4
1
3
10
5
6
7
2
J102
MULTI-FREQ.
INPUT
1
2
R120
47
R118
1.5K
R119
1K
1.55V
.6V
7.4V
2.0V
C121
.1UF
C122
82
R121
180
C123
.001UF
R122
47K
T101
1
4
3
C124
R123
270
C126
C125
.001UF
C127
.1UF
C128
T102
1
4
3
0V
L103
27
10.0V
C130
C131
30
T103
1
3
C132
.56
1.14V
C129
.047UF
R125
62
R24
10K
J103
1
2
3
4
5
6
7
POS B MULTI 2
POS A MULTI 1
POS C MULTI 3
A-
POS 6
A+
6
5
4
3
2
1
R1
UP 1
UP 2
C1
RC 2911
TYP

LOW FOR VALUE

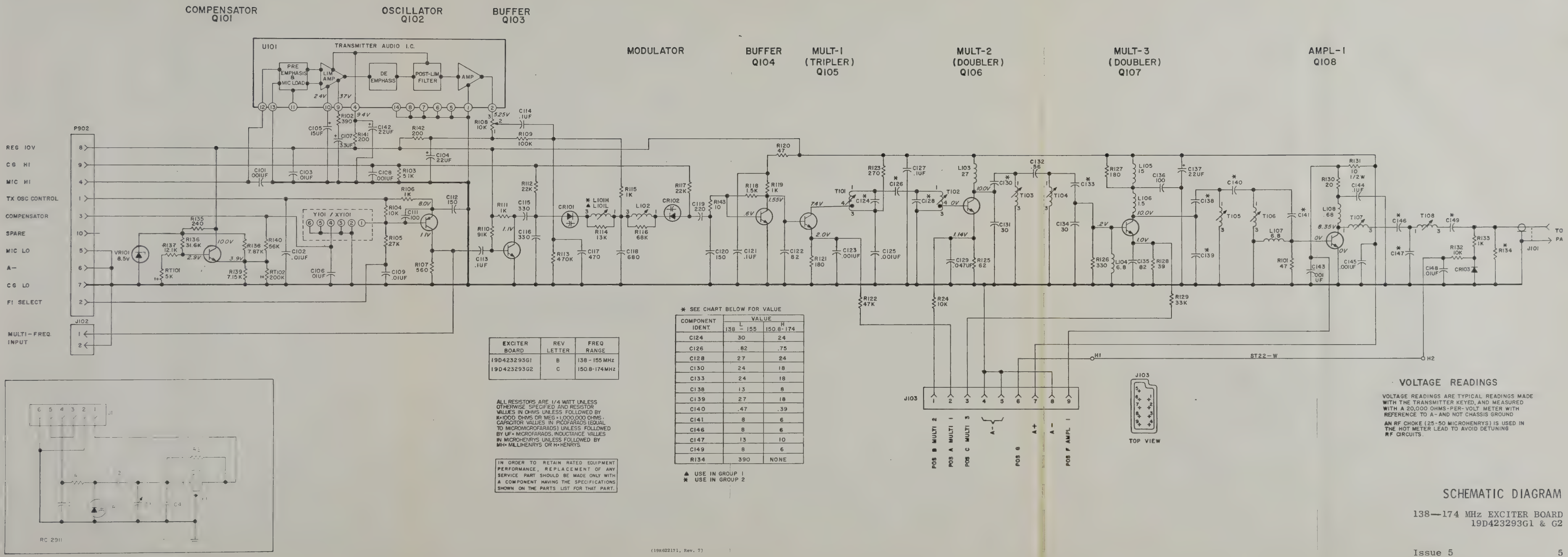
VALUE	
L 8 - 155	H 150.8-174
30	24
.82	.75
27	24
24	18
24	18
13	8
27	18
.47	.39
8	6
8	6
13	10
8	6
390	NONE

PARTS LIST

VEHICULAR REPEATER LOGIC BOARD
19C328461G1
ISSUE 1

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	19A134202P6	Tantalum: 22 µf ±20%, 15 VDCW.
C2	19A116080P1	Polyester: 0.01 µf ±20%, 50 VDCW.
C3 and C4	5494481P7	Ceramic disc: 470 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C5	19A134202P10	Tantalum: 680 µf ±10%, 35 VDCW.
C7	19A134202P5	Tantalum: 3.3 µf ±20%, 15 VDCW.
C8	19A134202P10	Tantalum: 680 µf ±10%, 35 VDCW.
C9	19A134202P105	Tantalum: 3.3 µf ±10%, 15 VDCW.
C10	5494481P7	Ceramic disc: 470 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C11	19A134202P108	Tantalum: 15 µf ±10%, 20 VDCW.
C12	19A116080P107	Polyester: 0.1 µf ±10%, 50 VDCW.
C13	19A134202P107	Tantalum: 2.2 µf ±10%, 20 VDCW.
C14 and C15	19A134202P108	Tantalum: 15 µf ±10%, 20 VDCW.
C16	19A134202P7	Tantalum: 2.2 µf ±20%, 20 VDCW.
C17 thru C20	19A116080P107	Polyester: 0.1 µf ±10%, 50 DCW.
C21 and C22	19A134202P6	Tantalum: 22 µf ±20%, 15 VDCW.
C23	5494481P7	Ceramic disc: 470 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C24 and C25	19A134202P5	Tantalum: 3.3 µf ±20%, 15 VDCW.
C26 and C27	5494481P7	Ceramic disc: 470 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C28	19A134202P5	Tantalum: 3.3 µf ±20%, 15 VDCW.
C29	19A116080P1	Polyester: 0.01 µf ±20%, 50 VDCW.
C30	5494481P7	Ceramic disc: 470 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C31	19A134202P7	Tantalum: 2.2 µf ±20%, 20 VDCW.
C34 thru C49	19A116080P1	Polyester: 0.01 µf ±20%, 50 VDCW.
C50	19A134202P9	Tantalum: 0.1 µf ±20%, 35 VDCW.
C51	19A116080P1	Polyester: 0.01 µf ±20%, 50 VDCW.
C52	19A134202P108	Tantalum: 15 µf ±10%, 20 VDCW.
C53	19A134202P107	Tantalum: 2.2 µf ±10%, 20 VDCW.
C54 and C55	5494481P7	Ceramic disc: 470 pf ±20%, 1000 VDCW; sim to
		- - - - - - - - DIODES AND RECTIFIERS - - - - - -
CR1 thru CR9	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
		- - - - - - - - - - - - PLUGS - - - - - - - - - -
P904	19A116659P3	Connector, printed wiring: 8 contacts; sim to Molex 09-52-3082.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	3R152P224J	Composition: 220K ohms ±5%, 1/4 w.
R2	3R152P154J	Composition: 150K ohms ±5%, 1/4 w.
R3	3R152P334J	Composition: 330K ohms ±5%, 1/4 w.
R4	3R152P474J	Composition: 470K ohms ±5%, 1/4 w.
R5	3R152P104J	Composition: 100K ohms ±5%, 1/4 w.
R6	3R152P474J	Composition: 470K ohms ±5%, 1/4 w.
R7	3R152P104J	Composition: 100K ohms ±5%, 1/4 w.
R8	19C314256P22103	Metal film: 210K ohms ±1%, 1/4 w.
R9	19C314256P25620	Metal film: 562 ohms ±1%, 1/4 w.
R10	3R152P474J	Composition: 470K ohms ±5%, 1/4 w.
R11	3R152P223J	Composition: 22K ohms ±5%, 1/4 w.
R12	19C314256P21433	Metal film: 143K ohms ±1%, 1/4 w.
R13	19A116559P108	Variable, cermet: 50K ohms ±20%, 0.5 w; sim to CTS Series 360.
R14	3R152P474J	Composition: 470K ohms ±5%, 1/4 w.
R15	19C314256P22103	Metal film: 210K ohms ±1%, 1/4 w.
R16	19C314256P22323	Metal film: 232K ohms ±1%, 1/4 w.
R17 thru R19	3R152P224J	Composition: 220K ohms ±5%, 1/4 w.
R20	3R152P154J	Composition: 150K ohms ±5%, 1/4 w.
R21	3R152P224J	Composition: 220K ohms ±5%, 1/4 w.
R22	3R152P104J	Composition: 100K ohms ±5%, 1/4 w.
R23	3R152P334J	Composition: 330K ohms ±5%, 1/4 w.
R24 and R25	3R152P474J	Composition: 470K ohms ±5%, 1/4 w.
R26	3R152P334J	Composition: 330K ohms ±5%, 1/4 w.
R27 thru R29	3R152P224J	Composition: 220K ohms ±5%, 1/4 w.
R30 and R31	3R152P335J	Composition: 3.3 megohms ±5%, 1/4 w.
R32	3R152P124J	Composition: 120K ohms ±5%, 1/4 w.
R33	3R152P154J	Composition: 150K ohms ±5%, 1/4 w.
R34 and R35	3R152P224J	Composition: 220K ohms ±5%, 1/4 w.
R36	3R152P274J	Composition: 270K ohms ±5%, 1/4 w.
R40	3R152P104J	Composition: 100K ohms ±5%, 1/4 w.
R41 and R42	3R152P224J	Composition: 220K ohms ±5%, 1/4 w.
R43	3R152P564J	Composition: 560K ohms ±5%, 1/4 w.
R44	3R152P104J	Composition: 100K ohms ±5%, 1/4 w.
R45 thru R49	3R152P103J	Composition: 10K ohms ±5%, 1/4 w.
		- - - - - - - - TEST POINTS - - - - - - - - - -
TP1	19B211379P1	Spring (Test Point).
TP3 thru TP10	19B211379P1	Spring (Test Point).
		- - - - - - - INTEGRATED CIRCUITS - - - - - - -
U1 thru U4	19A134097P55	Digital, Quad 2-Input or Gate: Identification No. 4071.
U5 and U6	19A134097P56	Digital, Quad 2-Input and Gate: Identification No. 4081.
U7	19A134097P341	Digital, Hex Buffer/Converter (Inverting): Identification No. 4049 UB.
U8 and U9	19A134097P9	Digital, Quad 2-Input Nand Gate: Identification No. 4011.
U10	19A134097P3	Digital, Dual 4-Input Nor Gate: Identification No. 4002.
U11	19A134097P61	Digital, Triple 3-Input And Gate: Identification No. 4073.
U12 and U13	19A134097P2	Digital, Quad 2-Input Nor Gate: Identification No. 4001.
U14 thru U16	19A134097P341	Digital, Hex Buffer/Converter (Inverting): Identification No. 4049 UB.
U17	19A134097P208	Digital, Binary Up/Down Counter: Identification No. 4516.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES


COMPENSATOR
Q101
OSCILLATOR
Q102
BUFFER
Q103
MODULATOR
BUFFER
Q104
MULT-1
(TRIPLER)
Q105
MULT-2
(DOUBLER)
Q106
MULT-3
(DOUBLER)
Q107
AMPL-1
Q108
U101
TRANSMITTER AUDIO I.C.
PRE EMPHASIS & MIC LOAD
LIM AMP
DE EMPHASIS
POST-LIM FILTER
AMP
P902
REG 10V
CG HI
MIC HI
TX OSC CONTROL
COMPENSATOR
SPARE
MIC LO
A−
CG LO
F1 SELECT
J102
MULTI-FREQ INPUT
Y101 / XY101
VR101 8.5V
CR101
CR102
CR103
T101
T102
T103
T104
T105
T106
T107
T108
J101
TO PA
H1
ST22-W
H2
J103
POS B MULTI 2
POS A MULTI 1
POS C MULTI 3
A−
POS 6
A+
A−
POS F AMPL 1
J103
TOP VIEW
J1
RC 2911

TYPICAL CRYSTAL MODULE

✱ SEE CHART BELOW FOR VALUE

COMPONENT IDENT.	VALUE	
	L 138 − 155	H 150.8-174
C124	30	24
C126	.82	.75
C128	27	24
C130	24	18
C133	24	18
C138	13	8
C139	27	18
C140	.47	.39
C141	8	6
C146	8	6
C147	13	10
C149	8	6
R134	390	NONE

▲ USE IN GROUP 1
✱ USE IN GROUP 2

EXCITER BOARD	REV LETTER	FREQ RANGE
19D423293G1	B	138 - 155 MHz
19D423293G2	C	150.8-174 MHz

ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.

IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.

VOLTAGE READINGS

VOLTAGE READINGS ARE TYPICAL READINGS MADE WITH THE TRANSMITTER KEYED, AND MEASURED WITH A 20,000 OHMS-PER-VOLT METER WITH REFERENCE TO A- AND NOT CHASSIS GROUND

AN RF CHOKE (25-50 MICROHENRYS) IS USED IN THE HOT METER LEAD TO AVOID DETUNING RF CIRCUITS.

(19B622171, Rev. 7)

SCHEMATIC DIAGRAM

138—174 MHz EXCITER BOARD
19D423293G1 & G2

"Revision
includes all
ions.

CR101

LBI30817
(DF3166)

MAINTENANCE MANUAL

138—174 MHz RF OUTPUT MODULE 19D429881G1

TABLE OF CONTENTS

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DESCRIPTION 1
CIRCUIT ANALYSIS 1
OUTLINE DIAGRAMS 2
SCHEMATIC DIAGRAM 3
PARTS LISTS 4

DESCRIPTION

The RF Output Module contains the PA/Antenna Switch Assembly for the MASTR® Executive II Vehicular Repeater and uses a single RF power transistor to provide a power output of 300 milliwatts. A solid state antenna switch is used to switch the antenna from the receiver to the power amplifier output circuit.

Supply voltage for the PA is connected through cable W215 to the System Board. C3, C4, C5 and L4 prevent RF from getting on the power input lines.

The hinged PA heat sink pivots 90° to provide access to the power amplifier/antenna switch board and low pass filter.

CIRCUIT ANALYSIS

The exciter output is coupled through an RF cable W216 to H2. The RF is then coupled by the microstrip to the base of RF power transistor Q1. A ground on the TX ENABLE line turns Q2 on and forward biases CR1 permitting the RF output of Q1 to be coupled through cable W214 to the low pass filter. The RF is prevented from reaching the receiver circuit due to CR2 being reversed biased. CR2 is reversed biased since Q3 is turned on by the ground on the TX ENABLE line which turns off Q4. L5 and L6 prevent RF from affecting Q2 and Q4 operation.

The PA output is coupled through the low pass filter and appears at the antenna jack J202. A 20 dB pad provides isolation between the antenna circuit and the monitor receiver jack J201. Isolation is also provided by the pad between the repeater receiver and transmitter circuit and the monitor receiver.

A receive signal at J202 is coupled through the low pass filter and cable W214 to the antenna switch circuit. When the transmitter is not keyed, the TX ENABLE is high. Q3 is turned off, so Q4 is turned on. With Q4 on, CR2 is forward biased and permits the receive signal to appear at P102. CR1 is reversed biased to prevent any RF from the exciter from being coupled to the receiver since Q2 will be off.

The receive signal is applied to the monitor receiver circuit J201 through the 20 dB pad on the low pass filter module.

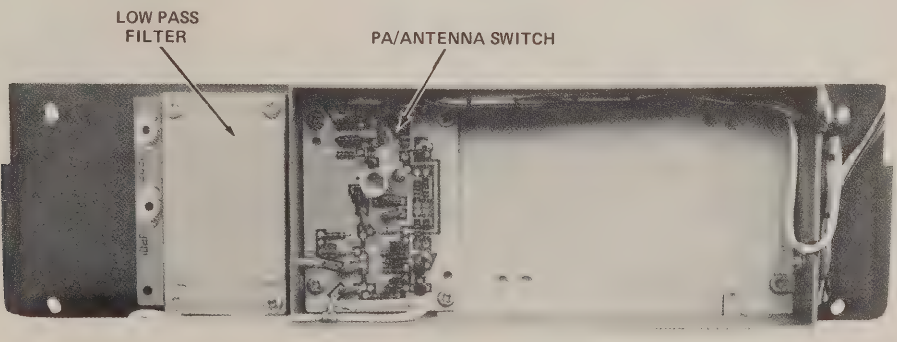

Figure 1 - PA/Antenna Switch

GENERAL ELECTRIC COMPANY • MOBILE COMMUNICATIONS DIVISION
WORLD HEADQUARTERS • LYNCHBURG, VIRGINIA 24502 U.S.A.

GENERAL ELECTRIC*
U.S.A.

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Printed in U.S.A.

PARTS LIST

LBI30064C

138-174 MHz EXCITER BOARD
19D423293G1 138-155 MHz
19D423293G2 150.8-174 MHz

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - - CAPACITORS - - - - - - - - - -
C101	19A116655P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C102 and C103	19A116080P1	Polyester: 0.01 µf ±20%, 50 VDCW.
C104	19A134202P6	Tantalum: 22 µf ±20%, 15 VDCW.
C105	5496267P14	Tantalum 15 µf ±20%, 20 VDCW; sim to Sprague Type 150D.
C106	19A116080P1	Polyester: 0.01 µf ±20%, 50 VDCW.
C107	5496267P9	Tantalum: 3.3 µf ±20%, 15 VDCW; sim to Sprague Type 150D.
C108	19A116655P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C109	19A116080P101	Polyester: 0.01 µf ±10%, 50 VDCW.
C111	19A116656P100J7	Ceramic disc: 100 pf ±5%, 500 VDCW, temp coef -750 PPM.
C112	19A700105P38	Mica: 150 pf ±5%, 500 VDCW.
C113 and C114	19A116080P107	Polyester: 0.1 µf ±10%, 50 VDCW.
C115 and C116	5490008P39	Silver mica: 330 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C117	5494481P107	Ceramic disc: 470 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C118	5493366P680J	Mica: 680 pf ±5%, 100 VDCW; sim to Electro Motive Type DM-15.
C119	5490008P35	Silver mica: 220 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C120	5490008P31	Silver mica: 150 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C121	19A116080P107	Polyester: 0.1 µf ±10%, 50 VDCW.
C122	19A700105P32	Mica: 82 pf ±5%, 500 VDCW.
C123	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C124L	5496219P250	Ceramic disc: 30 pf ±5%, 500 VDCW, temp coef -80 PPM.
C124H	5496219P248	Ceramic disc: 24 pf ±5%, 500 VDCW, temp coef -80 PPM.
C125	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C126H	5491601P118	Phenolic: 0.75 pf ±5%, 500 VDCW.
C126L	19A700013P12	Phenolic: 0.82 pf ±5%, 500 VDCW.
C127	19A116080P107	Polyester: 0.1 µf ±10%, 50 VDCW.
C128L	5496219P249	Ceramic disc: 27 pf ±5%, 500 VDCW, temp coef -80 PPM.
C128H	5496219P248	Ceramic disc: 24 pf ±5%, 500 VDCW, temp coef -80 PPM.
C129	19A116080P105	Polyester: 0.047 µf ±10%, 50 VDCW.
C130L	5496219P248	Ceramic disc: 24 pf ±5%, 500 VDCW, temp coef -80 PPM.
C130H	5496219P245	Ceramic disc: 18 pf ±5%, 500 VDCW, temp coef -80 PPM.
C131	5496219P250	Ceramic disc: 30 pf ±5%, 500 VDCW, temp coef -80 PPM.
C132	19A700013P10	Phenolic: 0.56 pf ±5%, 500 VDCW.
C133L	5496219P248	Ceramic disc: 24 pf ±5%, 500 VDCW, temp coef -80 PPM.
C133H	5496219P245	Ceramic disc: 18 pf ±5%, 500 VDCW, temp coef -80 PPM.
C134	5496219P250	Ceramic disc: 30 pf ±5%, 500 VDCW, temp coef -80 PPM.
C135	19A700105P32	Mica: 82 pf ±5%, 500 VDCW.
C136	5490008P127	Silver mica: 100 pf ±10%, 500 VDCW; sim to Electro Motive Type DM-15.
C137	5496267P10	Tantalum. 22 µf ±20%, 15 VDCW; sim to Sprague Type 150D.
C138L	5496219P243	Ceramic disc: 13 pf ±5%, 500 VDCW, temp coef -80 PPM.
C138H	5496219P239	Ceramic disc: 8.0 pf ±5%, 500 VDCW, temp coef -80 PPM.
C139L	5496219P249	Ceramic disc: 27 pf ±5%, 500 VDCW, temp coef -80 PPM.
C139H	5496219P245	Ceramic disc: 18 pf ±5%, 500 VDCW, temp coef -80 PPM.
C140L	19A700013P9	Phenolic: 0.47 pf ±5%, 500 VDCW.
C140H	19A700013P8	Phenolic: 0.39 pf ±5%, 500 VDCW.
C141L	5496219P239	Ceramic disc: 8.0 pf ±5%, 500 VDCW, temp coef -80 PPM.
C141H	5496219P237	Ceramic disc: 6.0 pf ±0.25 pf, 500 VDCW, temp -80 PPM.
C142	19A134202P6	Tantalum: 22 µf ±20%, 15 VDCW.
C143	19A116655P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C144	19A116080P107	Polyester: 0.1 µf ±10%, 50 VDCW.
C145	19A116655P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C146L	5496219P239	Ceramic disc: 8.0 pf ±0.25 pf, 500 VDCW, temp coef -80 PPM.
C146H	5496219P237	Ceramic disc: 6.0 pf ±0.25 pf, 500 VDCW, temp coef -80 PPM.
C147L	5496219P243	Ceramic disc: 13 pf ±5%, 500 VDCW, temp coef -80 PPM.
C147H	5496219P241	Ceramic disc: 10 pf ±0.25 pf, 500 VDCW, temp coef -80 PPM.
C148	19A116080P1	Polyester: 0.01 µf ±20%, 50 VDCW.
C149L	5496219P239	Ceramic disc: 8.0 pf ±0.25 pf, 500 VDCW, temp coef -80 PPM.
C149H	5496219P237	Ceramic disc: 6.0 pf ±0.25 pf, 500 VDCW, temp coef -80 PPM.
		- - - - - - - - DIODES AND RECTIFIERS - - - - - - -
CR101* and CR102*	5495769P9	Diode, silicon.
		Earlier than REV A:
	5495769P8	Diode, silicon.
CR103	19A115250P1	Silicon.
		- - - - - - - - JACKS AND RECEPTACLES - - - - - - -
J101	19A130924G1	Connector. Includes:
	19A116832P1	Receptacle, coaxial: jack type; sim to Cinch 14H11613.
J102	19A700090P3	Contact, electrical: sim to Molex 08-50-0404. (Quantity 2).
J103	19B219374G1	Connector: 9 contacts.
		- - - - - - - - - - - INDUCTORS - - - - - - - - - -
L101*	19C307171P101	Coil, RF. Deleted in G2 by REV B.
L101H*	19C307171P106	Coil, RF. Added to G2 by REV B.
L101L	19C307171P101	Coil, RF.
L102L	19C307171P102	Coil, RF.
L102H*	19C307171P106	Coil, RF.
		In REV A & earlier:
	19C307171P101	Coil, RF.
L103	19B209420P130	Coil, RF: 27.0 µh ±10%, 3.60 ohms DC res max; sim to Jeffers 441316-5K.
L104	19A700024P23	Coil, RF: 6.8 µh ±10%, 2.00 ohms DC res max.
L105	19A700000P25	Coil, RF: 15.0 µh ±10%, 1.20 ohms DC res max.
L106	19A700000P14	Coil, RF: 1.50 µh ±10%, 0.485 ohms DC res max.
L107	19A700024P23	Coil, RF: 6.80 µh ±10%, 2.00 ohms DC res max.
L108	19A700000P10	Coil, RF: 0.68 µh ±10%, 0.15 ohms DC res max.
		- - - - - - - - - - - - PLUGS - - - - - - - - - - -
P902	19A116659P2	Connector, printed wiring: 10 contacts; sim to Molex 09-52-3102.
		- - - - - - - - - - - TRANSISTORS - - - - - - - - -
Q101	19A116774P1	Silicon, NPN; sim to Type 2N5210.
Q102	19A115852P1	Silicon, PNP; sim to Type 2N3906.
Q103	19A115910P1	Silicon, NPN; sim to Type 2N3904.
Q104 and Q105	19A115330P1	Silicon, NPN.
Q106	19A115328P1	Silicon, NPN.
Q107*	19A116201P1	Silicon, NPN.
		In G1 of REV A & earlier, G2 of REV B & earlier:
	19A115329P2	Silicon, NPN.
Q108*	19A116868P1	Silicon, NPN; sim to Type 2N4427.
		In G1 of REV A & earlier, G2 of REV B & earlier:
	19A115329P2	Silicon, NPN.
		- - - - - - - - - - - - RESISTORS - - - - - - - - - - -
R101*	19A700106P31	Composition: 47 ohms ±5%, 1/4 w.
		In G1 of REV A & earlier, G2 of REV B & earlier:
	3R152P151J	Composition: 150 ohms ±5%, 1/4 w.
R102	19A700106P53	Composition: 390 ohms ±10%, 1/4 w.
R103	3R152P512J	Composition: 5100 ohms ±5%, 1/4 w.
R104	19A700106P87	Composition: 10K ohms ±5%, 1/4 w.
R105	19A700106P97	Composition: 27K ohms ±5%, 1/4 w.
R106	19A700106P63	Composition: 1K ohms ±5%, 1/4 w.
R107	19A700106P57	Composition: 560 ohms ±5%, 1/4 w.
R108	19B209358P106	Variable, carbon film: approx 300 to 10,000 ohms ±10%, 0.25 w; sim to CTS Type X-201.
R109	3R152P104K	Composition: 100K ohms ±10%, 1/4 w.
R110	3R152P913J	Composition: 91K ohms ±5%, 1/4 w.
R111	19A700106P63	Composition: 1K ohms ±10%, 1/4 w.
R112	19A700106P95	Composition: 22K ohms ±10%, 1/4 w.
R113	3R152P474J	Composition: 470K ohms ±5%, 1/4 w.
R114	3R152P133J	Composition: 13K ohms ±5%, 1/4 w.
R115	19A700106P63	Composition: 1K ohms ±10%, 1/4 w.
R116	3R152P683K	Composition: 68K ohms ±10%, 1/4 w.
R117	19A700106P95	Composition: 22K ohms ±5%, 1/4 w.
R118	3R152P152K	Composition: 1.5K ohms ±10%, 1/4 w.
R119	19A700106P63	Composition: 1K ohms ±10%, 1/4 w.
R120	19A700106P31	Composition: 47 ohms ±5%, 1/4 w.
R121	19A700106P45	Composition: 180 ohms ±10%, 1/4 w.
R122	19A700106P103	Composition: 47K ohms ±10%, 1/4 w.
R123	19A700106P49	Composition: 270 ohms ±10%, 1/4 w.
R124	19A700106P87	Composition: 10K ohms ±10%, 1/4 w.
R125	3R152P620J	Composition: 62 ohms ±5%, 1/4 w.
R126	19A700106P51	Composition: 330 ohms ±10%, 1/4 w.
R127	19A700106P45	Composition: 180 ohms ±10%, 1/4 w.
R128	19A700106P29	Composition: 39 ohms ±10%, 1/4 w.
R129	3R152P333K	Composition: 33K ohms ±10%, 1/4 w.
R130	3R152P200J	Composition: 20 ohms ±5%, 1/4 w.
R131	19A700113P15	Composition: 10 ohms ±5%, 1/2 w.
R132	19A700106P87	Composition: 10K ohms ±10%, 1/4 w.
R133	19A700106P63	Composition: 1K ohms ±10%, 1/4 w.
R134	19A700106P53	Composition: 390 ohms ±10%, 1/4 w.
R135	3R152P241J	Composition: 240 ohms ±5%, 1/4 w.
R136	19C314256P23162	Metal film: 31.6K ohms ±1%, 1/4 w.
R137	19C314256P21212	Metal film: 12.1K ohms ±1%, 1/4 w.
R138	19C314256P27871	Metal film: 7.87K ohms ±1%, 1/4 w.
R139	19C314256P27151	Metal film: 7.15K ohms ±1%, 1/4 w.
R140	19A700106P105	Composition: 56K ohms ±5%, 1/4 w.
R141 and R142	19A700106P46	Composition: 200 ohms ±5%, 1/4 w.
R143	19A700106P15	Composition: 10 ohms ±10%, 1/4 w.
		- - - - - - - - - - - THERMISTORS - - - - - - - - -
RT101	19C300048P7	Disc: 5000 ohms ±10%; sim to NL 1D103.
RT102	19C300048P5	Disc: 200K ohms ±10%; sim to NL 4D051.
		- - - - - - - - - - - TRANSFORMERS - - - - - - - -
		Paul Smith Co. Sample No. 08-2874-WS-6.
T101	19C307170P301	Coil, RF: variable, wire size No. 20 AWG; sim to Paul Smith Co. Sample No. 08-2874-WS-2.
T102	19C307170P302	Coil, RF: variable, wire size No. 20 AWG; sim to Paul Smith Co. Sample No. 08-2874-WS-6.
T103 and T104	19C307170P303	Coil, RF: variable, wire size No. 20 AWG; sim to Paul Smith Co. Sample No. 071774-OG-6.
T105 and T106	19C307169P201	Coil, RF: variable, wire size No. 20 AWG; sim to Paul Smith Co. Sample No. 091774-WS-1.
T107 and T108	19C307170P304	Coil, RF: variable, wire size No. 20 AWG; sim to Paul Smith Co. Sample No. 071774-OG-3.
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - - -
U101	19D416542G2	Transmitter, Audio.
		- - - - - - - - - VOLTAGE REGULATORS - - - - - - -
VR101	4036887P9	Zener: 500 mW, 8.5 v. nominal.
		- - - - - - - - - - - SOCKETS - - - - - - - - - -
XY101	19A116659P50	Connector, printed wiring: 6 contacts; sim to Molex 09-65-1061.
		- - - - - - - - - - CRYSTAL MODULE - - - - - - - -
		NOTE: When reordering, give GE Part Number and specify exact operating frequency needed.
Y101	19B226962G4	Tx. 5 PPM (138-155 MHz).
	19B226962G5	Tx. 5 PPM (150.8-174 MHz).
		- - - - - - - - - - MISCELLANEOUS - - - - - - - -
	19A129424G2	Can. (Used with L101, L102, T101-T108).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

PRODUCTION CHANGES

Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter," which is stamped after the model number of the unit. The revision stamped on the unit includes all previous revisions. Refer to the Parts List for descriptions of parts affected by these revisions.

REV. A - Exciter Board 19D423293G1 & G2

To improve tuning on high end of frequency band. Changed CR101 and CR102.

REV. B - Exciter Board 19D423293G2

To improve band end tuning. Changed L101 and L102.

MOBILE RADIO

LBI30817
(DF3166)

MAINTENANCE MANUAL

138—174 MHz RF OUTPUT MODULE 19D429881G1

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Page
DESCRIPTION 1
CIRCUIT ANALYSIS 1
OUTLINE DIAGRAMS 2
SCHEMATIC DIAGRAM 3
PARTS LISTS 4

DESCRIPTION

The RF Output Module contains the PA/Antenna Switch Assembly for the MASTR® Executive II Vehicular Repeater and uses a single RF power transistor to provide a power output of 300 milliwatts. A solid state antenna switch is used to switch the antenna from the receiver to the power amplifier output circuit.

Supply voltage for the PA is connected through cable W215 to the System Board. C3, C4, C5 and L4 prevent RF from getting on the power input lines.

The hinged PA heat sink pivots 90° to provide access to the power amplifier/antenna switch board and low pass filter.

CIRCUIT ANALYSIS

The exciter output is coupled through an RF cable W216 to H2. The RF is then coupled by the microstrip to the base of RF power transistor Q1. A ground on the TX ENABLE line turns Q2 on and forward biases CR1 permitting the RF output of Q1 to be coupled through cable W214 to the low pass filter. The RF is prevented from reaching the receiver circuit due to CR2 being reversed biased. CR2 is reversed biased since Q3 is turned on by the ground on the TX ENABLE line which turns off Q4. L5 and L6 prevent RF from affecting Q2 and Q4 operation.

The PA output is coupled through the low pass filter and appears at the antenna jack J202. A 20 dB pad provides isolation between the antenna circuit and the monitor receiver jack J201. Isolation is also provided by the pad between the repeater receiver and transmitter circuit and the monitor receiver.

A receive signal at J202 is coupled through the low pass filter and cable W214 to the antenna switch circuit. When the transmitter is not keyed, the TX ENABLE is high. Q3 is turned off, so Q4 is turned on. With Q4 on, CR2 is forward biased and permits the receive signal to appear at P102. CR1 is reversed biased to prevent any RF from the exciter from being coupled to the receiver since Q2 will be off.

The receive signal is applied to the monitor receiver circuit J201 through the 20 dB pad on the low pass filter module.

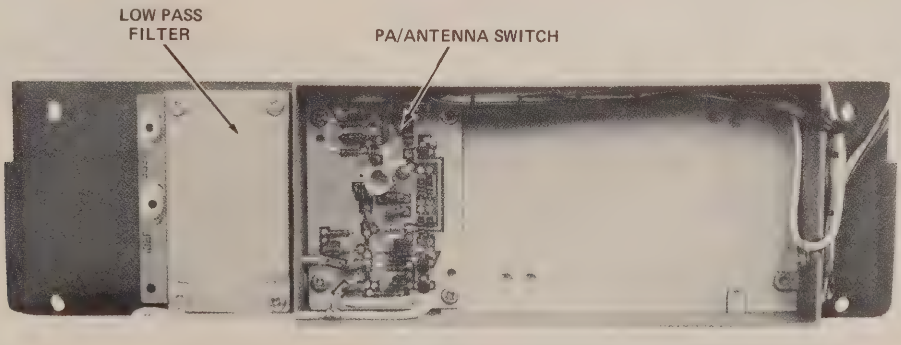
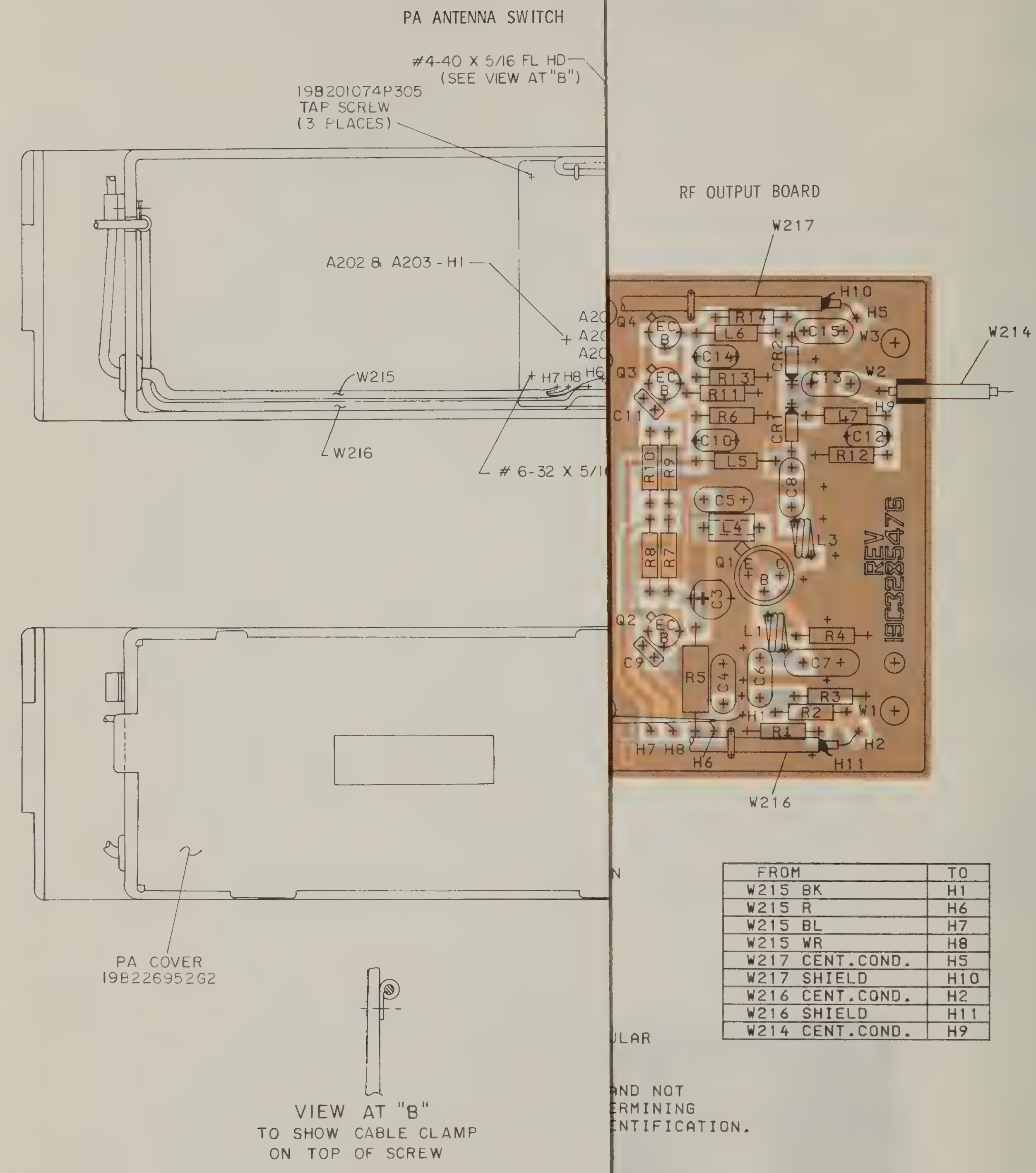


Figure 1 - PA/Antenna Switch

GENERAL ELECTRIC COMPANY • MOBILE COMMUNICATIONS DIVISION
WORLD HEADQUARTERS • LYNCHBURG, VIRGINIA 24502 U.S.A.

GENERAL ELECTRIC*
U.S.A.

* Trademark of General Electric Company U.S.A.
Printed in U.S.A.


PA ANTENNA SWITCH
#4-40 X 5/16 FL HD
(SEE VIEW AT "B")
19B201074P305
TAP SCREW
(3 PLACES)
A202 & A203 - H1
A20
A20
A20
W215
W216
H7 H8 H6
# 6-32 X 5/1
RF OUTPUT BOARD
W217
W214
H10
H5
W3
W2
H9
Q4
Q3
Q2
Q1
E C B
R14
L6
C15
C14
CR2
R13
C13
R11
C11
R6
L7
CR1
C12
C10
L5
R12
R10
R9
C5
C8
L4
L3
R8
R7
REV
19C323547G
C3
R4
L1
C7
C9
R5
C4
C6
R3
R2
W1
H1
R1
H2
H7 H8
H6
H11
W216
PA COVER
19B226952G2
VIEW AT "B"
TO SHOW CABLE CLAMP
ON TOP OF SCREW

FROM	TO
W215 BK	H1
W215 R	H6
W215 BL	H7
W215 WR	H8
W217 CENT.COND.	H5
W217 SHIELD	H10
W216 CENT.COND.	H2
W216 SHIELD	H11
W214 CENT.COND.	H9

N

ULAR

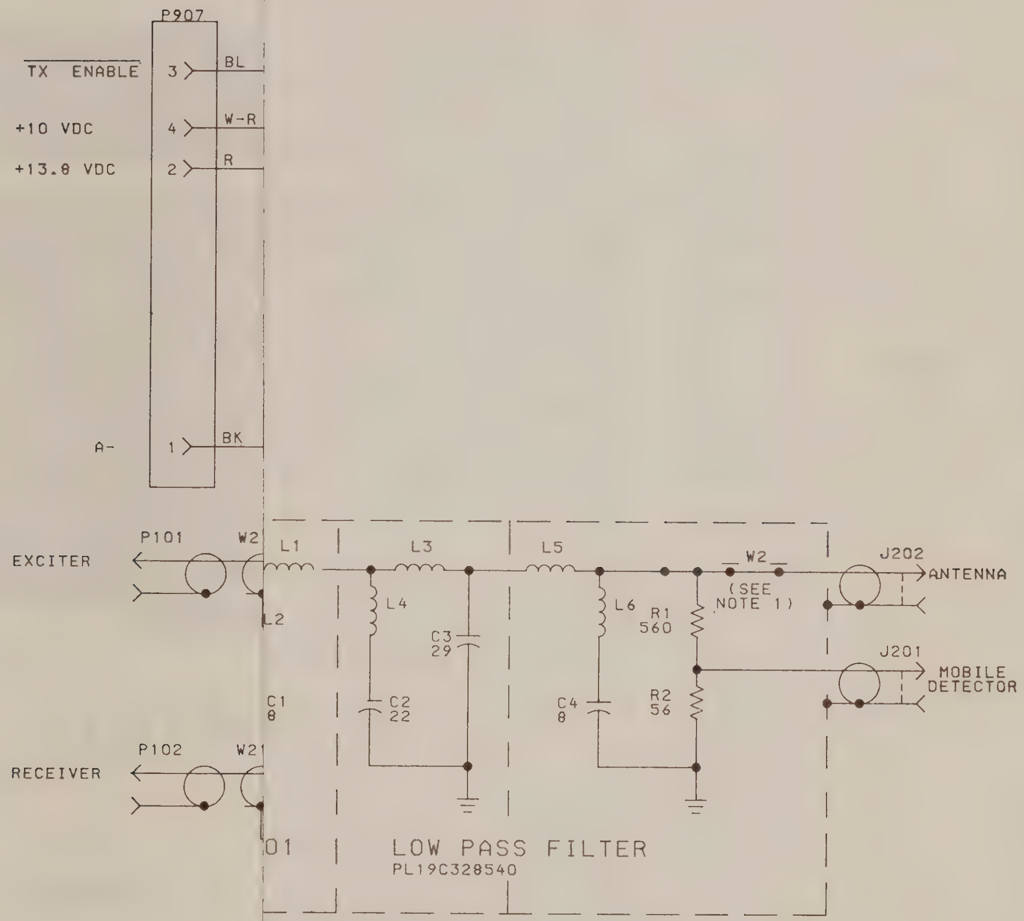
AND NOT
ERMINING
ENTIFICATION.

8548, Rev. 0)
8408, Sh. 1, Rev. 0)
8408, Sh. 2, Rev. 0)

(19C330483

OUTLINE DIAGRAM

PA/ANTENNA SWITCH &
RF OUTPUT MODULE


P907
TX ENABLE
3
BL
+10 VDC
4
W-R
+13.8 VDC
2
R
A-
1
BK
P101
W2
EXCITER
L1
L2
C1
8
P102
W21
RECEIVER
01
L3
L4
C2
22
C3
29
L5
L6
C4
8
R1
560
R2
56
W2
(SEE NOTE 1)
J202
ANTENNA
J201
MOBILE DETECTOR
LOW PASS FILTER
PL19C328540

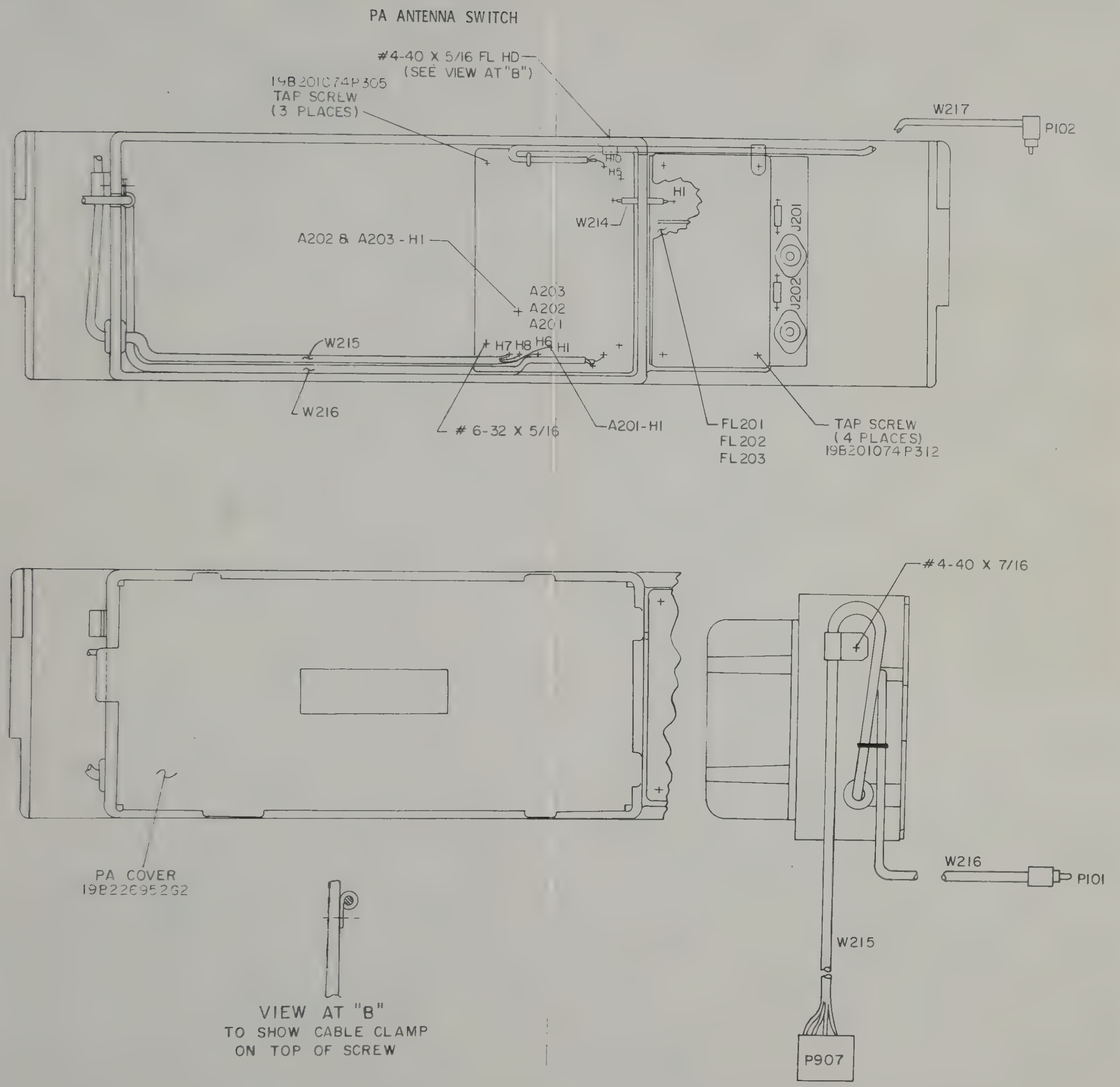
MODEL NO	REV LETTER
PL19D429881G1	
PL19C328547G1	
PL19C328540G1	

SCHEMATIC DIAGRAM

RF OUTPUT MODULE 19D429881G1

Issue 1

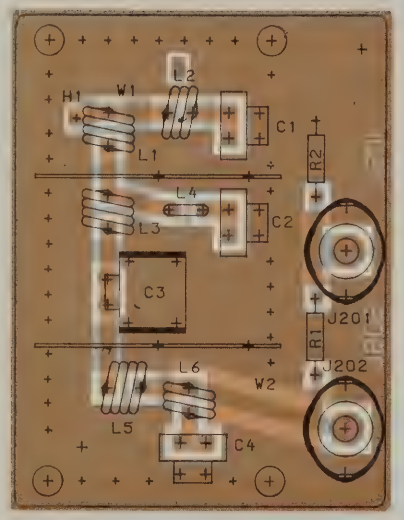
PA ANTENNA SWITCH


#4-40 X 5/16 FL HD
(SEE VIEW AT "B")
19B201074P305
TAP SCREW
(3 PLACES)
W217
P102
H10
H5
H1
W214
A202 & A203 - H1
A203
A202
A201
J201
J202
W215
H7 H8 H6 H1
W216
# 6-32 X 5/16
A201-H1
FL201
FL202
FL203
TAP SCREW
(4 PLACES)
19B201074P312
#4-40 X 7/16
PA COVER
19B226952G2
W216
P101
W215
P907

VIEW AT "B"
TO SHOW CABLE CLAMP
ON TOP OF SCREW

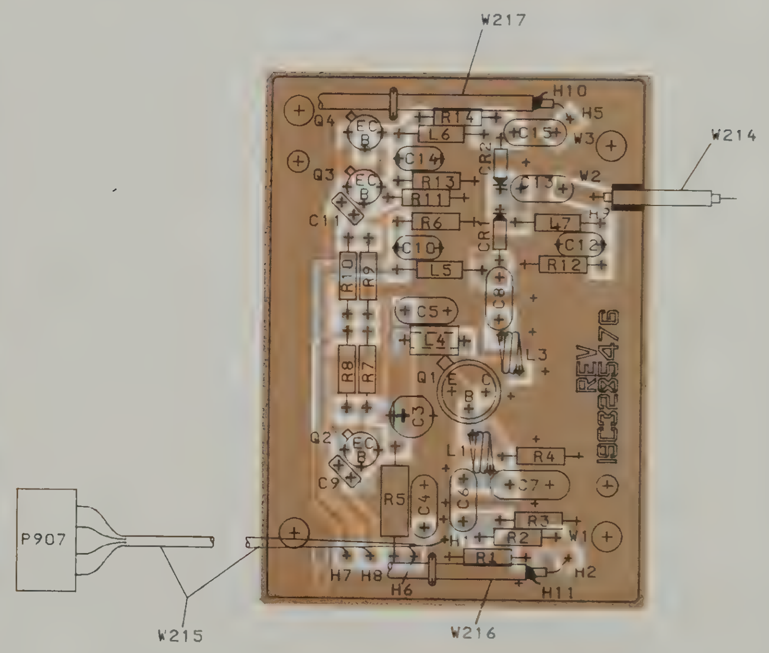
(19C330483, Rev. 0)

LOW PASS FILTER

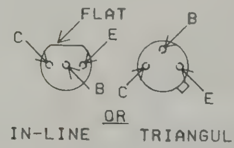

H1
W1
L2
C1
L1
R2
L4
C2
L3
C3
J201
R1
J202
L6
W2
L5
C4

(19C328541, Rev. 0)
(19A138405, Sh. 1, Rev. 0)
(19A138405, Sh. 2, Rev. 0)

RF OUTPUT BOARD


W217
H10
H5
W214
Q4
R14
L6
C15
W3
C14
CR2
Q3
R13
C13
W2
R11
C11
R6
L7
H9
CR1
C10
C12
R10
R9
L5
R12
C5
C8
C4
L3
R8
R7
Q1
E
C
B
C3
REV
19C328547 6
Q2
L1
R4
C9
C7
R5
C4
C6
R3
H1
R2
W1
R1
H7 H8
H6
H2
H11
P907
W215
W216

LEAD IDENTIFICATION
FOR Q1-Q4

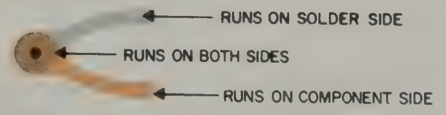

FLAT
C
E
B
B
C
E
OR

IN-LINE TRIANGULAR
TOP VIEW

NOTE: LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

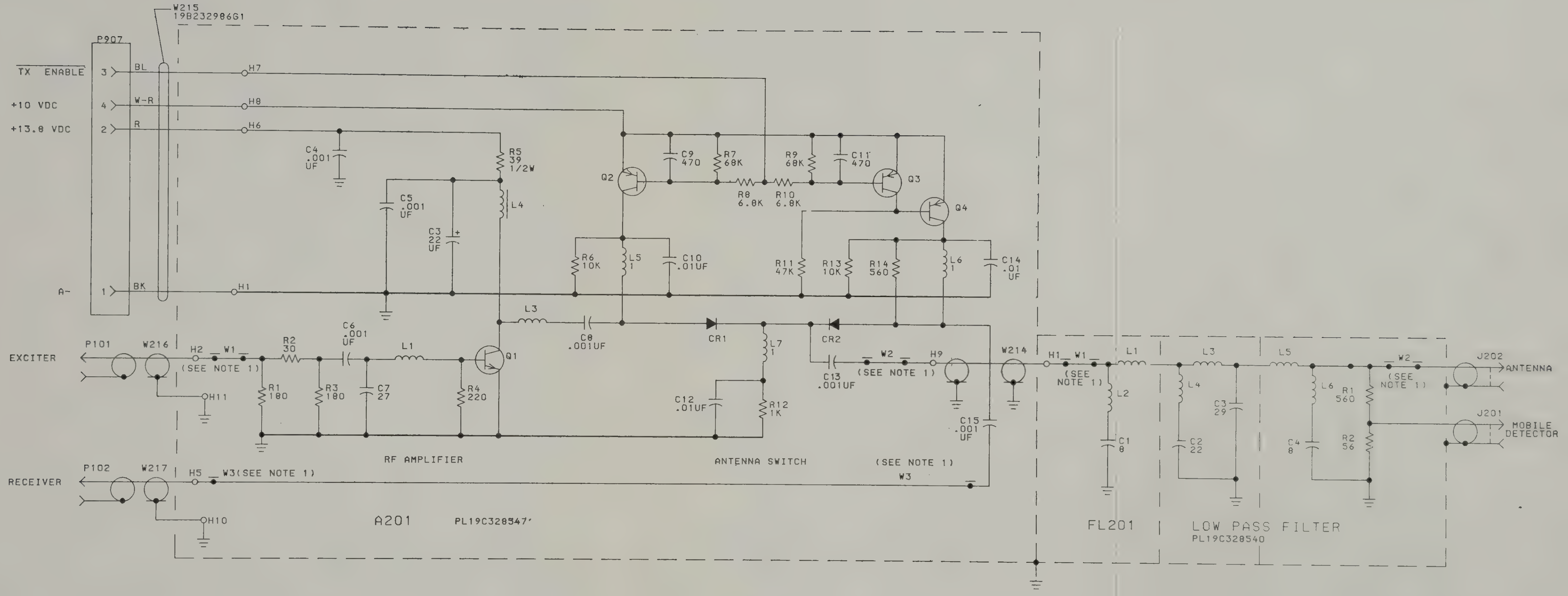
FROM	TO
W215 BK	H1
W215 R	H6
W215 BL	H7
W215 WR	H8
W217 CENT.COND.	H5
W217 SHIELD	H10
W216 CENT.COND.	H2
W216 SHIELD	H11
W214 CENT.COND.	H9

(19C328548, Rev. 0)
(19A138408, Sh. 1, Rev. 0)
(19A138408, Sh. 2, Rev. 0)


RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE

OUTLINE DIAGRAM

PA/ANTENNA SWITCH & RF OUTPUT MODULE


W215
19B232986G1
P907
TX ENABLE
+10 VDC
+13.8 VDC
A-
BL
W-R
R
BK
3
4
2
1
H7
H8
H6
H1
C4
.001
UF
C5
.001
UF
C3
22
UF
R5
39
1/2W
L4
Q2
C9
470
R7
68K
R8
6.8K
R9
68K
R10
6.8K
C11
470
Q3
Q4
R6
10K
L5
1
C10
.01UF
R11
47K
R13
10K
R14
560
L6
1
C14
.01
UF
L3
C8
.001UF
CR1
CR2
L7
1
C12
.01UF
R12
1K
C13
.001UF
W2
(SEE NOTE 1)
H9
C15
.001
UF
W214
EXCITER
P101
W216
H2
W1
(SEE NOTE 1)
H11
R2
30
C6
.001
UF
L1
R1
180
R3
180
C7
27
R4
220
Q1
RF AMPLIFIER
ANTENNA SWITCH
(SEE NOTE 1)
W3
RECEIVER
P102
W217
H5
W3(SEE NOTE 1)
H10
A201
PL19C328547
H1
W1
(SEE NOTE 1)
L1
L2
C1
8
L3
L4
C3
29
C2
22
L5
L6
C4
8
R1
560
R2
56
W2
(SEE NOTE 1)
J202
ANTENNA
J201
MOBILE
DETECTOR
FL201
LOW PASS FILTER
PL19C328540

NOTES:
1. MICROSTRIP (PART OF P.W. BD.)

ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF=MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH=MILLIHENRYS OR H=HENRYS.

MODEL NO	REV LETTER
PL19D429881G1	
PL19C328547G1	
PL19C328540G1	

(19D429662, Rev. 1)

SCHEMATIC DIAGRAM

RF OUTPUT MODULE 19D429881G1

Issue 1

SYMBOL	GE PART NO.	DESCRIPTION
	N80P9007C6	Machine screw: No. 4-40 x 7/16. (Secures W215 clip loop).
	19B201074P312	Tap screw, Phillips POZIDRIV®: No. 6-32 x 3/4. (Secures FL201 casting).
	19B201074P305	Tap screw, Phillips POZIDRIV®: No. 6-32 x 5/16. (Secures A201 board- 3 places).
	N80P13005C6	Machine screw: No. 6-32 x 5/16. (Secures A201- 1 place).
	19A129361P2	Shield. (Located on FL201).
	4036555P1	Insulator, washer: nylon. (Used with Q1 on A201).
	19A121252P1	Heat sink. (Used with Q1 on A201).

MOBILE RADIO

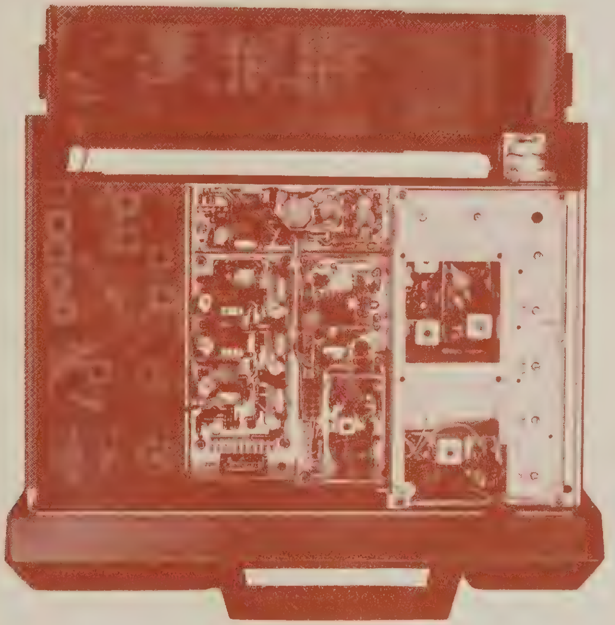
MASTR® *Executive II* MAINTENANCE MANUAL

138-174 MHz RECEIVER

Maintenance Manual LBI30055 D

(DF1112, THIS SHEET ONLY)

138-174 MHz MASTR EXECUTIVE II RECEIVER



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SPECIFICATIONS ii

DESCRIPTION AND MAINTENANCE LBI30130 (DF1112)

RF ASSEMBLY AND MIXER/IF BOARD LBI4980 (DF1107)

OSCILLATOR/MULTIPLIER LBI30057 (DF1106)

IF-DETECTOR LBI30049 (DF1105)

GENERAL ELECTRIC

PARTS LIST

138-174 MHz RF OUTPUT MODULE
19D429881G1
ISSUE 1

SYMBOL	GE PART NO.	DESCRIPTION
A201		AMPLIFIER/ANTENNA SWITCH 19C328547G1
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C3	19A134202P6	Tantalum: 22 µf ±20%, 15 VDCW.
C4 thru C6	19A116655P20	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C7	7489162P13	Silver mica: 27 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C8	19A116655P20	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C9	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-A050-W5R-471M.
C10	19A116080P101	Polyester: 0.01 µf ±10%, 50 VDCW.
C11	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-A050-W5R-471M.
C12	19A116080P101	Polyester: 0.01 µf ±10%, 50 VDCW.
C13	19A116655P20	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C14	19A116080P101	Polyester: 0.01 µf ±10%, 50 VDCW.
C15	19A116655P20	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
		- - - - - - - DIODES AND RECTIFIERS - - - - - -
CR1 and CR2	19A116925P1	Silicon, pin: 35 volt Reverse Breakdown, 400 mW.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L1	19A129774P1	Coil.
L3	19A129774P1	Coil.
L4	19A129773G1	Coil.
L5 thru L7	19B209420P113	Coil, RF: 1.00 µh ±10%, 0.74 ohms DC res max; sim to Jeffers 4426-6.
		- - - - - - - - - - - PLUGS - - - - - - - - - - -
P907		(Part of W215).
		- - - - - - - - - - TRANSISTORS - - - - - - - - -
Q1	19A116868P1	Silicon, NPN; sim to Type 2N4427.
Q2 thru Q4	19A115852P1	Silicon, PNP; sim to Type 2N3906.
		- - - - - - - - - - RESISTORS - - - - - - - - -
R1	3R152P181J	Composition: 180 ohms ±5%, 1/4 w.
R2	3R152P300J	Composition: 30 ohms ±5%, 1/4 w.
R3	3R152P181J	Composition: 180 ohms ±5%, 1/4 w.
R4	3R152P221J	Composition: 220 ohms ±5%, 1/4 w.
R5	3R77P390J	Composition: 39 ohms ±5%, 1/2 w.
R6	3R152P103J	Composition: 10K ohms ±5%, 1/4 w.
R7	3R152P683J	Composition: 68K ohms ±5%, 1/4 w.
R8	3R152P682J	Composition: 6.8K ohms ±5%, 1/4 w.
R9	3R152P683J	Composition: 68K ohms ±5%, 1/4 w.
R10	3R152P682J	Composition: 6.8K ohms ±5%, 1/4 w.
R11	3R152P473J	Composition: 47K ohms ±5%, 1/4 w.
R12	3R152P102J	Composition: 1K ohms ±5%, 1/4 w.
R13	3R152P103J	Composition: 10K ohms ±5%, 1/4 w.
R14	3R152P561J	Composition: 560 ohms ±5%, 1/4 w.
		- - - - - - - - - - - CABLES - - - - - - - - - -
W1 thru W3		(Part of printed board 19C328546P1).
W214	19A130607G1	Cable, RF: approx 1.14 inches long.
W215		CABLE ASSEMBLY 19B232986G1
		- - - - - - - - - - - - PLUGS - - - - - - - - - - - -
P907		Connector. Includes:
	19A116659P84	Shell.
	19A116781P6	Contact, electrical: sim to Molex 08-50-0108. (Quantity 4).
W216	19A130909G3	Cable, RF: approx 15.75 inches long.
W217	19A130909G4	Cable, RF: approx 22.75 inches long.
FL201		LOW PASS FILTER 19C328540G1
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C1	19A116679P8D	Metallized teflon: 8 pf ±.5 pf, 250 VDCW.
C2	19A700015P12	Teflon/Mica: 22 pf ±5%, 250 VDCW.
C3	19A116795P29J	Metallized teflon: 29 pf ±5%, 250 VDCW.
C4	19A116679P8D	Metallized teflon: 8 pf ±.5 pf, 250 VDCW.
		- - - - - - - - JACKS AND RECEPTACLES - - - - -
J201 and J202	19A130924G1	Connector, receptacle: coaxial, jack type; sim to Cinch 14H11613.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L1	19A129569P1	Coil.
L2	19A129570P1	Coil.
L3	19A129569P1	Coil.
L4	19A129575P1	Coil.
L5	19A129569P1	Coil.
L6	19A129570P1	Coil.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	3R152P561J	Composition: 560 ohms ±5%, 1/4 w.
R2	3R152P560J	Composition: 56 ohms ±5%, 1/4 w.
		- - - - - - - - - - - CABLES - - - - - - - - - - -
W1 and W2		(Part of printed board 19C328539P1).
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19C321591G9	Heat sink casting.
	19D416275P3	Casting. (FL201).
	19B226952G2	PA Cover.
	4029851P3	Clip loop. (Secures W215).
	N80P9007C6	Machine screw: No. 4-40 x 7/16. (Secures W215 clip loop).
	19B201074P312	Tap screw, Phillips POZIDRIV®: No. 6-32 x 3/4. (Secures FL201 casting).
	19B201074P305	Tap screw, Phillips POZIDRIV®: No. 6-32 x 5/16. (Secures A201 board- 3 places).
	N80P13005C6	Machine screw: No. 6-32 x 5/16. (Secures A201-1 place).
	19A129361P2	Shield. (Located on FL201).
	4036555P1	Insulator, washer: nylon. (Used with Q1 on A201)
	19A121252P1	Heat sink. (Used with Q1 on A201).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

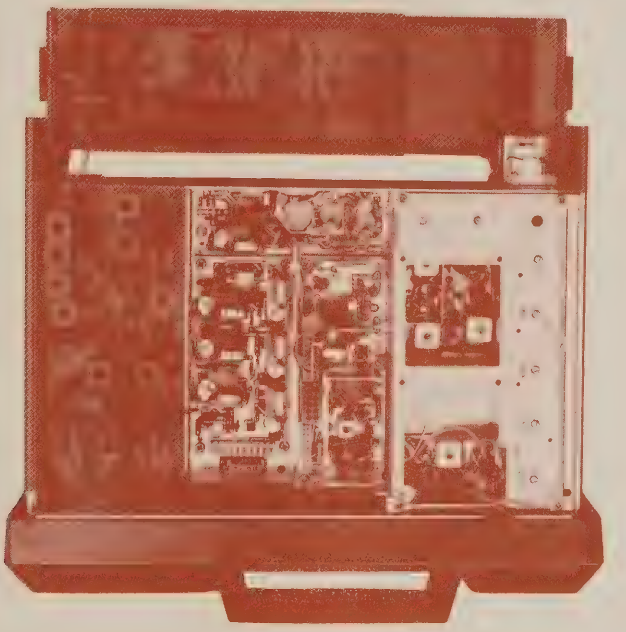
MOBILE RADIO

MASTR® *Executive II*
MAINTENANCE MANUAL
138-174 MHz RECEIVER

Maintenance Manual LBI30055D

(DF1112, THIS SHEET ONLY)

138-174 MHz MASTR EXECUTIVE II RECEIVER



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SPECIFICATIONS ii

DESCRIPTION AND MAINTENANCE LBI30130 (DF1112)

RF ASSEMBLY AND MIXER/IF BOARD LBI4980 (DF1107)

OSCILLATOR/MULTIPLIER LBI30057 (DF1106)

IF-DETECTOR LBI30049 (DF1105)

GENERAL ELECTRIC

SPECIFICATIONS*

Audio Output (to 3.2 ohm Speaker)	5 Watts at less than 5% distortion		

	Standard Receiver	Ultra-High Sensitivity Receiver	RCC & IMTS Receiver
Sensitivity			
12 dB SINAD (EIA Method)	0.35 µV	0.175 µV	0.5 µV
20 dB Quieting Method	0.50 µV	0.25 µV	0.63 µV
Selectivity			
EIA Two-Signal Method	-90 dB	-90 dB	-90 dB
Spurious Response	-100 dB	-95 dB	-100 dB (TX Unkeyed) -85 dB (TX Keyed)
Intermodulation (EIA)	-85 dB	-80 dB	-80 dB
Frequency Stability	±0.0005%		±0.0005%
Modulation Acceptance	±7 kHz		±7 kHz
Squelch Sensitivity			
Fixed Squelch	4 dB SINAD		

Maximum Frequency Separation	Full Specifications	3 dB degradation
138-155 MHz	0.900 MHz	1.60 MHz
150.8-174 MHz	1.0 MHz	1.80 MHz

Frequency Response	Within +1 and -8 dB of a standard 6 dB per octave de-emphasis curve from 300 to 3000 Hz (100 Hz reference)
RF Input Impedance	50 ohms

* These specifications are intended primarily for the use of the serviceman. Refer to the appropriate Specification Sheet for the complete specifications.

WARNING

Although the highest DC voltage in MASTR Executive II Mobile Equipment is supplied by the vehicle battery, high currents may be drawn under short circuit conditions. These currents can possibly heat metal objects such as tools, rings, watchbands, etc., enough to cause burns. Be careful when working near energized circuits!

High-level RF energy in the transmitter Power Amplifier assembly can cause RF burns upon contact. Keep away from these circuits when the transmitter is energized!

GENERAL ELECTRIC COMPANY • MOBILE COMMUNICATIONS DIVISION
WORLD HEADQUARTERS • LYNCHBURG, VIRGINIA 24502 U.S.A.

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U.S.A.

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LBI30130E
(DF1112)
(DF1118, IMTS)

DESCRIPTION AND MAINTENANCE

138—174 MHz MASTR® EXECUTIVE II RECEIVER

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DESCRIPTION .... Page 1

MAINTENANCE .... Page 1

Disassembly .... Page 1

Alignment Procedure .... Page 3

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HIGH SIDE INJECTION MODIFICATION .... Page 8

DESCRIPTION

MASTR® Executive II, 138 to 174 megahertz receivers are single conversion, superheterodyne FM receivers designed for one- through four-frequency operation. The solid state receiver utilizes integreted circuits (ICs), monolithic crystal filters and discrete components with each of the crystal filters located between gain stages to provide 85 dB selectivity and maximum protection from de-sensitization and intermodulation.

The receiver consists of the following modules:

RF Assembly

Mixer/IF (MIF)

Oscillator/Multiplier (Osc/Mult)

Audio and Squelch circuits (part of System-Audio & Squelch (SAS) board)

IF Detector (IF Det)

Optional Ultra-High Sensitivity (UHS) Pre-Amplifier

Audio, supply voltages and control functions are connected to the system board through P903 on the IF Det board, and through W401 to the Osc/Mult board. The regulated +10 Volts is used for all receiver stages except the audio PA stage which operates from the A+ system supply.

Centralized metering jack J601 on the IF Det board is provided for use with GE Test Set 4EX3A11 or Test Kit 4EX8K12. The test set meters the oscillator, multiplier, FM Detector and IF amplifier stages. Speaker high and low are metered on the system board metering jack.

A block diagram of the complete receiver is shown in Figure 1.

Refer to the appropriate Maintenance Manual for complete details on each receiver module as listed in the Table of Contents.

MAINTENANCE

DISASSEMBLY

To gain access to the receiver for servicing, unlock the radio and remove the two retaining screws in the front cover. Then pull the radio out of the mounting frame.

To remove the receiver modules from the radio:

1. Remove all power to the radio.
2. Remove the three countersunk Phillips head screws in the siderail of the radio near the RF casting. NOTE: Do NOT remove the three screws in the bracket along the top edge of the RF casting.
3. Loosen the screws in the two locking tabs on the corners of the RF casting and release the tabs.
4. Remove the two screws securing the IF-Det board to the mounting frame.

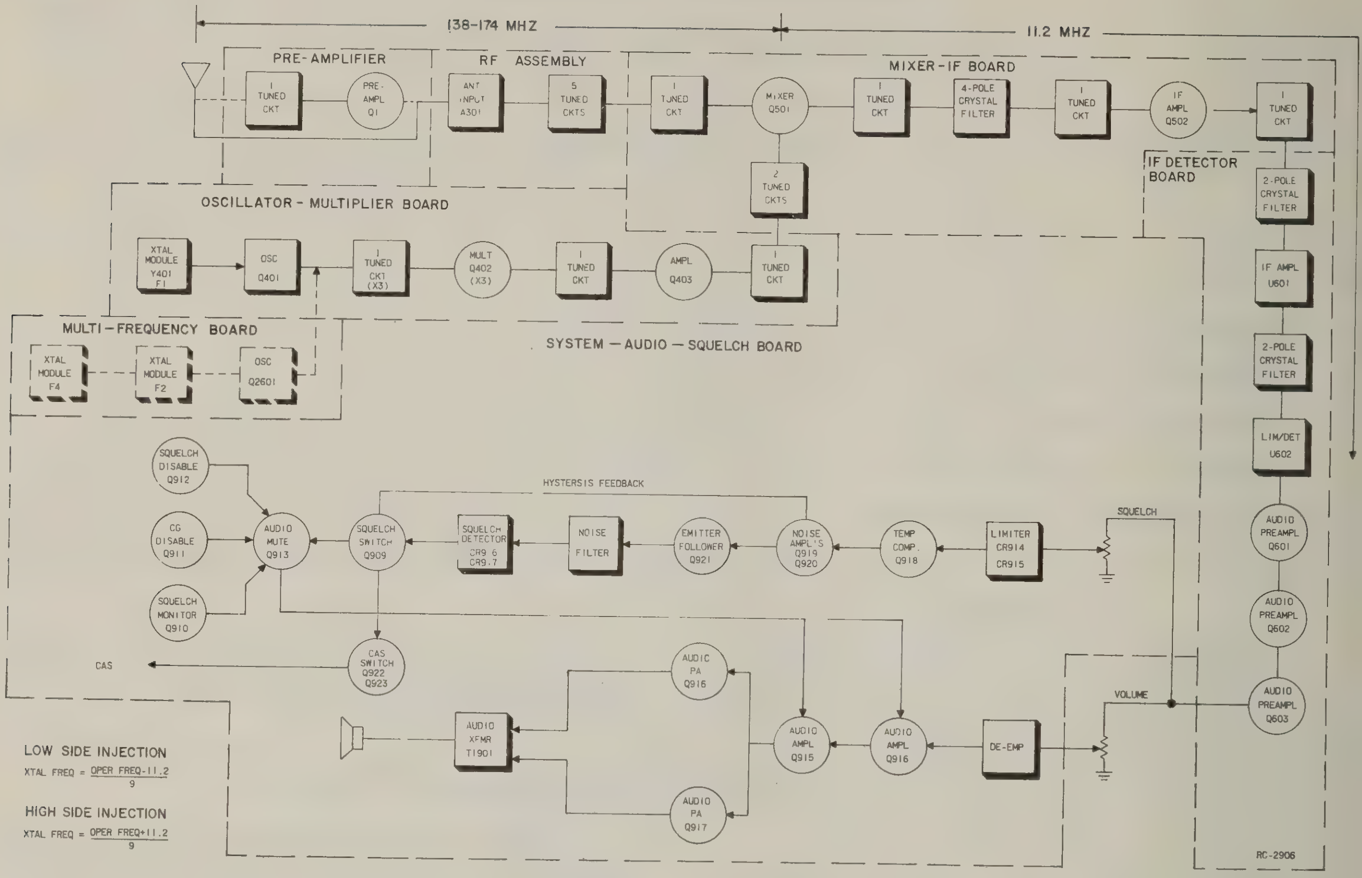
138-174 MHZ
11.2 MHZ
PRE-AMPLIFIER
1 TUNED CKT
PRE-AMPL Q1
RF ASSEMBLY
ANT INPUT A301
5 TUNED CKTS
MIXER-IF BOARD
1 TUNED CKT
MIXER Q501
1 TUNED CKT
4-POLE CRYSTAL FILTER
1 TUNED CKT
IF AMPL Q502
1 TUNED CKT
2 TUNED CKTS
IF DETECTOR BOARD
2-POLE CRYSTAL FILTER
IF AMPL U601
2-POLE CRYSTAL FILTER
LIM/DET U602
OSCILLATOR - MULTIPLIER BOARD
XTAL MODULE Y401 F1
OSC Q401
1 TUNED CKT (X3)
MULT Q402 (X3)
1 TUNED CKT
AMPL Q403
1 TUNED CKT
MULTI-FREQUENCY BOARD
XTAL MODULE F4
XTAL MODULE F2
OSC Q2601
SYSTEM — AUDIO — SQUELCH BOARD
SQUELCH DISABLE Q912
CG DISABLE Q911
SQUELCH MONITOR Q910
AUDIO MUTE Q913
SQUELCH SWITCH Q909
HYSTERSIS FEEDBACK
SQUELCH DETECTOR CR9 6 CR9 7
NOISE FILTER
EMITTER FOLLOWER Q921
NOISE AMPL'S Q919 Q920
TEMP COMP. Q918
LIMITER CR914 CR915
SQUELCH
CAS
CAS SWITCH Q922 Q923
AUDIO PA Q916
AUDIO XFMR T1901
AUDIO AMPL Q915
AUDIO AMPL Q916
DE-EMP
VOLUME
AUDIO PA Q917
AUDIO PREAMPL Q601
AUDIO PREAMPL Q602
AUDIO PREAMPL Q603
LOW SIDE INJECTION
XTAL FREQ = OPER FREQ-11.2 / 9
HIGH SIDE INJECTION
XTAL FREQ = OPER FREQ+11.2 / 9
RC-2906

Figure 1 - Receiver Block Diagram

5. Remove the screw securing the Osc/Mult board.

6. Unplug the receiver antenna connector. In multi-frequency units, unplug the lead on the Osc/Mult board.

7. Lift the receiver modules out of the radio with a gentle rocking motion.

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WORLD HEADQUARTERS • LYNCHBURG, VIRGINIA 24502 U.S.A.

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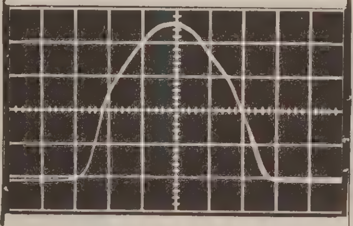
ITION timeter t J601-9	TUNING CONTROL	METER READING	PROCEDURE
MIXER & IF			
cuits have been aligned at the factory and will normally require no further adjustment. If adjustment is necessary, tlined in Step 13.			
NOTE — TAFILE BULLETIN 1000-6 (IF Alignment of Two-Way Radio FM Receivers) for helpful suggestions on how to deter- F Alignment is required.			
	L505, L520, L521 and C521 		Connect scope, signal generator, and probe as shown in Figure 2. Set signal generator level for 3 to 5 µV and modulate with 10 kHz at 20 Hz. With probe between J601-1 and A-, tune L505, L520, L521 and C521, for double trace as shown on scope pattern.
		See Procedure	Check to see that modulation acceptance bandwidth is greater than ±6.5 kHz.
SQUELCH ADJUST			
		30°	Set SQUELCH ADJUST control (R953) to open with a 6 dB SINAD signal. (Approximately 30° counterclockwise of critical squelch position).

ALIGNMENT PROCEDURE

138—174 MHz MASTR EXECUTIVE II RECEIVER

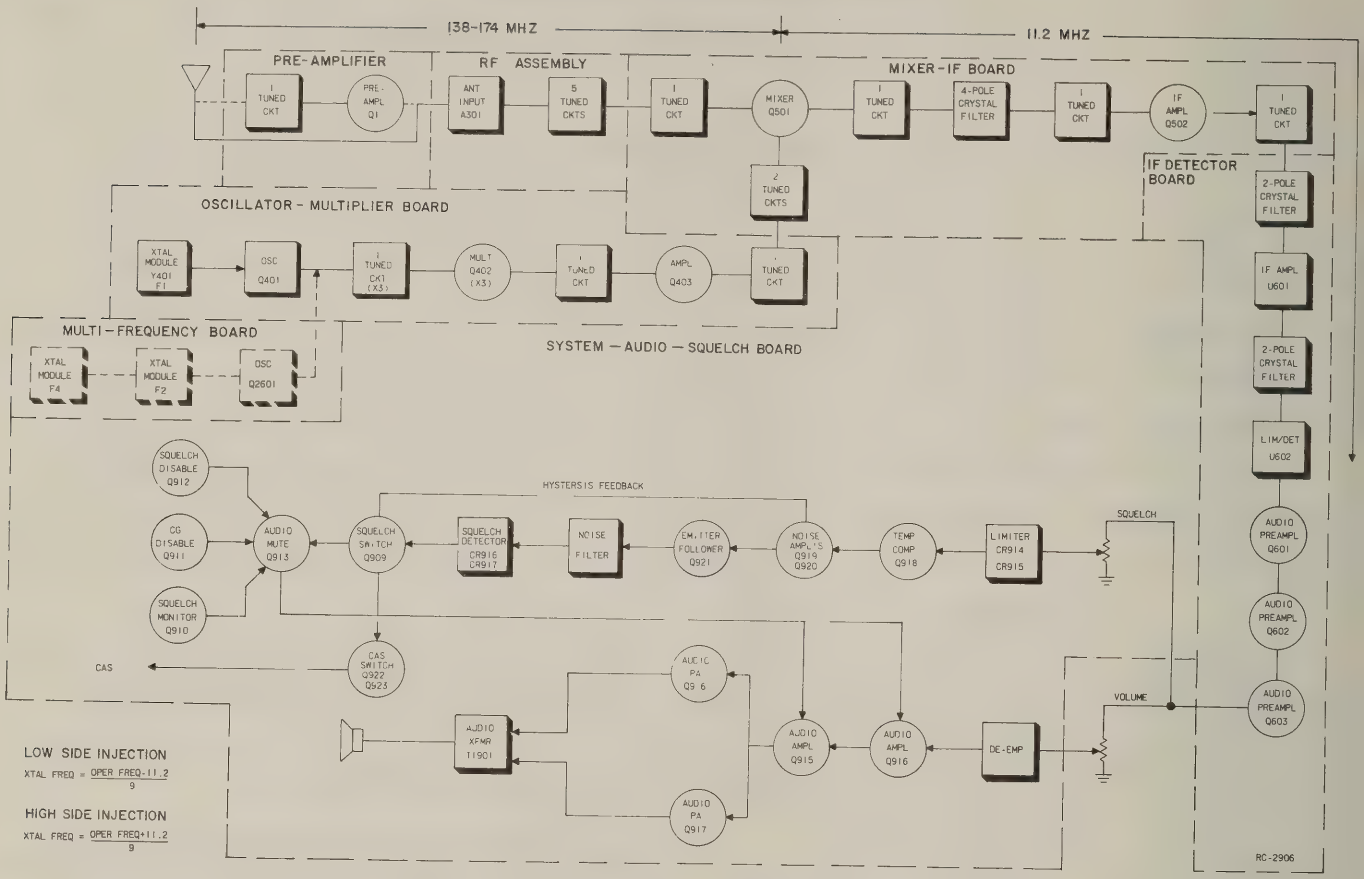

138-174 MHZ
11.2 MHZ
PRE-AMPLIFIER
1 TUNED CKT
PRE-AMPL Q1
RF ASSEMBLY
ANT INPUT A301
5 TUNED CKTS
MIXER-IF BOARD
1 TUNED CKT
MIXER Q501
1 TUNED CKT
4-POLE CRYSTAL FILTER
1 TUNED CKT
IF AMPL Q502
1 TUNED CKT
2 TUNED CKTS
IF DETECTOR BOARD
2-POLE CRYSTAL FILTER
IF AMPL U601
2-POLE CRYSTAL FILTER
LIM/DET U602
AUDIO PREAMPL Q601
AUDIO PREAMPL Q602
AUDIO PREAMPL Q603
OSCILLATOR - MULTIPLIER BOARD
XTAL MODULE Y401 F1
OSC Q401
1 TUNED CKT (X3)
MULT Q402 (X3)
1 TUNED CKT
AMPL Q403
TUNED CKT
MULTI-FREQUENCY BOARD
XTAL MODULE F4
XTAL MODULE F2
OSC Q2601
SYSTEM — AUDIO — SQUELCH BOARD
SQUELCH DISABLE Q912
CG DISABLE Q911
SQUELCH MONITOR Q910
AUDIO MUTE Q913
SQUELCH SWITCH Q909
SQUELCH DETECTOR CR916 CR917
NOISE FILTER
EMITTER FOLLOWER Q921
NOISE AMPL'S Q919 Q920
TEMP COMP Q918
LIMITER CR914 CR915
HYSTERSIS FEEDBACK
SQUELCH
CAS
CAS SWITCH Q922 Q923
AUDIO PA Q916
AUDIO PA Q917
AUDIO XFMR T1901
AUDIO AMPL Q915
AUDIO AMPL Q916
DE-EMP
VOLUME
LOW SIDE INJECTION
XTAL FREQ = OPER FREQ-11.2 / 9
HIGH SIDE INJECTION
XTAL FREQ = OPER FREQ+11.2 / 9
RC-2906

Figure 1 - Receiver Block Diagram

5. Remove the screw securing the Osc/Mult board.

6. Unplug the receiver antenna connector. In multi-frequency units, unplug the lead on the Osc/Mult board.

7. Lift the receiver modules out of the radio with a gentle rocking motion.

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FRONT END ALIGNMENT

EQUIPMENT

1. GE Test Set Models 4EX3A11, 4EX8K12 or 20,000 ohms-per-Volt multimeter with a 1-Volt scale.
2. A 138-174 MHz signal source.
3. Ammeter (capable of measuring 20 milliamperes).

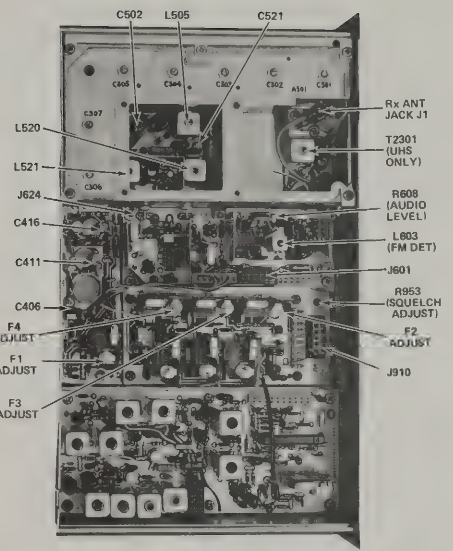
PRELIMINARY CHECKS AND ADJUSTMENTS

1. Connect black plug from Test Set to Receiver Centralized Metering Jack J601, and red plug to system board metering jack J910. Set range selector switch to the TEST 1 position (or 1-Volt position on 4EX8K12).
2. For multi-frequency receivers with a frequency spacing up to 0.450 MHz for frequency range of 138-155 MHz, or 0.500 MHz for frequency range of 150.8-174 MHz, align the receiver on the channel nearest center frequency.

   For multi-frequency receivers with a frequency spacing exceeding the above but no greater than .900 MHz for frequency range of 138-155 MHz, or 1.00 MHz for frequency range of 150.8-174 MHz, align the receiver using a center frequency tune-up crystal module. These limits can be extended to 1.60 MHz and 1.80 MHz respectively with 3 dB degradation in standard receiver specifications.
3. With Test Set in Position J, check for regulated +10 Volts. If necessary, adjust R906 for 10 Volts. If using multimeter, measure between J910-3 (+) and J910-9 (-).
4. Set SQUELCH ADJUST R953 to unmute the receiver and VOLUME control to minimum. Disconnect J906 on the SAS board and connect the milliammeter in series with J906 (+) and P906 (-). Adjust audio BIAS control on SAS board for 20 milliamperes. Re-adjust SQUELCH ADJUST to open with a 6 dB SINAD signal.
5. If using multimeter, connect the negative lead to J601-9 (A-).
6. Disable Channel Guard.

ALIGNMENT PROCEDURE

STEP	METERING POSITION		TUNING CONTROL	METER READING	PROCEDURE
	GE Test Set	Multimeter - at J601-9			
					OSCILLATOR-MULTIPLIER
1.	C (MULT-1)	Pin 3	C406	Maximum	Tune C406 for maximum meter reading.
2.			C411, C416, C306, C307	See Procedure	Preset C411 and C416 to a position similar to C406. Next, preset C306 and C307 fully counterclockwise (minimum capacity).
3.	D (MULT-2)	Pin 4	C411, C416, C406	See Procedure	Tune C411 and C416 for maximum meter reading. Next, retune C406, C411 and C416 for maximum meter reading, then, carefully dip C306 and tune C307 for maximum meter reading. Do NOT readjust C306 and C307.
					RF SELECTIVITY
4.	B (IF AMP)	Pin 1	C502, C301 thru C305 (and T2301 if present)	Maximum	Apply an on-frequency signal to the antenna jack, keeping the signal below saturation. Then tune C502 and C301 through C305 for maximum meter reading. In receivers with the UHS preamplifier, also tune T2301 for maximum meter reading.
5.	B (IF AMP)	Pin 1	C502, C301 thru C307 (and T2301 if present)	Maximum	Apply an on-frequency signal to the antenna jack and slightly tune C502, C301 through C305 (and T2301 if present) for best quieting sensitivity. C306 and C307 may also be tuned slightly (not exceeding 1/4 turn).



NOTE 1: Appendix A of DATAFILE Bulletin 1000-6 contains instructions for building a sweep modulator.

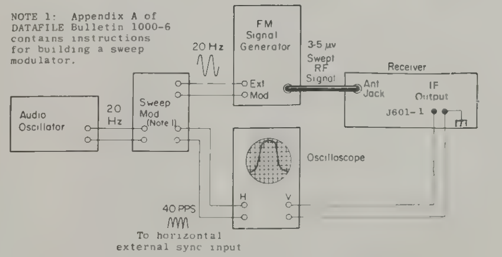


Figure 2 - Test Setup for 20-Hz Double-Trace Sweep Alignment

OSCILLATOR FREQUENCY ADJUSTMENT

First, check the frequency to determine if any adjustment is required. (Refer to frequency offset chart, Figure 3.) The frequency measurement requires equipment with an absolute accuracy that is 5 to 10 times better than the tolerance to be maintained. When adjusting the frequency, the entire radio should be as near as possible to an ambient temperature of 30°C (86°F).

The frequency of the crystal module should only be reset when the measured frequency error exceeds the following limits:

A. ±0.6 PPM when the ambient temperature of the radio is 30°C (86°F).

B. ±5 PPM at any other temperature within the range of -30°C to +75°C (-22°F to +167°F).

If frequency adjustment is required, refer to one of the procedures below (depending on equipment available) for proper adjustment.

A. DIRECT MEASUREMENT IN THE INJECTION CHAIN

1. WITH A FREQUENCY COUNTER. "Count" the frequency at the junction of C416 and L403 on the Oscillator-Multiplier board. The frequency measured at this point is 9 times the crystal frequency.
2. WITH A COMMUNICATION MONITOR (for example: Cushman Model CE-3). "Monitor" frequency at the junction of C416 and L403 on the Oscillator-Multiplier board. The frequency monitored at this point is 9 times the crystal frequency. NOTE. This frequency will not always fall within an available measuring range of all monitors at all receiver operating frequencies.

B. STANDARD "ON FREQUENCY" SIGNAL AT THE RECEIVER INPUT (Generated from a COMMUNICATION MONITOR, for example: Cushman Model CE-3).

1. WITH A FREQUENCY COUNTER. "Count" the developed IF frequency at the tap of Z602-R2 on the IF-DET board. The deviation from the nominal IF frequency (11.2 MHz) in Hz is compared to the receiver operating frequency (also in Hz) to calculate the frequency error.
2. WITH AN 11.2 MHz IF FREQUENCY STANDARD (for example: General Electric Model 4EX9A10). Loosely couple the IF frequency standard to the IF signal path to create a heterodyne with the developed IF frequency. The resultant "beat frequency" can be monitored by any of the following methods:

NOTE

To set crystal frequency using "beat frequency" method, the temperature should be at 30°C (86°F). If the temperature is not 30°C, then offset the "ON FREQUENCY" signal (at the receivers input), as a function of actual temperature, by the frequency ERROR FACTOR shown in Figure 3.

a. Audible "beat frequency" from the receiver speaker (this requires careful frequency adjustment of the frequency standard).

b. Observe "beat frequency" at J601-1 with an oscilloscope.

c. With GE TEST SET (Meter Position B) connected to J601 on the IF-DET Board, visually observe the "beat frequency" indicated by meter movement.

The frequency of the "beat" is the frequency error related to the IF frequency. This deviation, in Hz, is compared to the receiver operating frequency, also in Hz, to calculate the frequency error.

NOTE

The FM Detector output (meter position A of the test set) has a DC voltage of .35 to .50 volts at the assigned frequency and is provided for routine test and measurement only. The resolution of this reading (approximately .025 V per kHz as read on a GE Test Set in meter position A, or 0.1 V per kHz as measured with a VTVM at J601-2 on the IF-DET board) is inadequate for oscillator frequency setting.

If the radio is at an ambient temperature of 30°C (86°F) set the oscillator for the correct mixer frequency (crystal FREQ. X 9).

If the radio is not at an ambient temperature of 30°C setting errors can be minimized as follows:

A. To hold setting error to ±0.6 PPM (which is considered reasonable for 5 PPM oscillators):

1. Maintain the radio at 30°C (±5°C) and set the oscillator to required mixer injection frequency, or
2. Maintain the radio at 30°C (±5°C, -10°C) and offset the oscillator, as a function of actual temperature, by the frequency error shown in Figure 3.

For example: Assume the ambient temperature of the radio is 20°C (68°F). At that temperature, the curve shows a correction factor of 225 Hz.

Adjust the oscillator for a corrected mixer injection frequency 225 Hz higher. If a negative correction factor is obtained (at temperatures above 30°C, set the oscillator for the indicated frequency lower than the calculated mixer injection frequency.

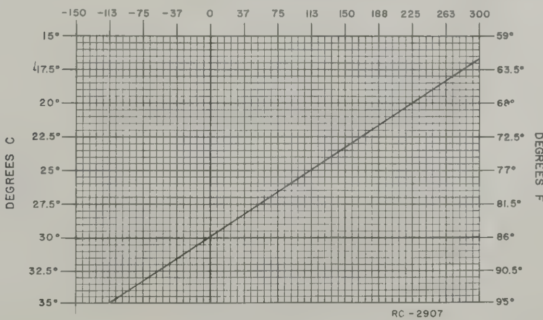


Figure 3 - Frequency Characteristics Vs. Temperature

COMPLETE RECEIVER ALIGNMENT

EQUIPMENT REQUIRED

1. GE Test Set Models 4EX3A11, 4EX8K12 or 20,000 ohms-per-Volt multimeter with a 1-Volt scale.
2. An 11.2 MHz signal source (GE Test Set Model 4EX9A10). Also a 138-174 MHz signal source (Measurements 803) with a one-inch piece of insulated wire no larger than .065 inch diameter connected to generator probe.
3. A VTVM.
4. Ammeter (capable of measuring 20 milliamperes).
5. Distortion Analyzer.

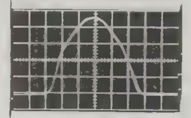
PRELIMINARY CHECKS AND ADJUSTMENTS

1. Connect the black plug from the Test Set to receiver metering jack J601, and the red plug to system board metering jack J910. Set the range selector switch to the Test 1 (or 1-Volt position on the 4EX8K12).
2. For multi-frequency receivers with a frequency spacing up to 0.450 MHz for frequency range of 138-155 MHz, or 0.500 MHz for frequency range of 150.8-174 MHz, align the receiver on the channel nearest center frequency.

   For multi-frequency receivers with a frequency spacing exceeding the above but no greater than .900 MHz for frequency range of 138-155 MHz, or 1.00 MHz for frequency range of 150.8-174 MHz, align the receiver using a center frequency tune-up crystal module. These limits can be extended to 1.60 MHz and 1.80 MHz respectively with 3 dB degradation in standard receiver specifications.
3. With the Test Set in Position J, check for regulated +10 Volts. If necessary, adjust R906 for 10 Volts. With multimeter. measure from J910-3 to J910-9.
4. Set SQUELCH ADJUST R953 to unmute the receiver and VOLUME control to minimum. Disconnect J906 on the SAS board and connect the milliammeter in series with J906 (+) and P906 (-). Adjust audio BIAS control on SAS board for 20 milliamperes. Re-adjust SQUELCH ADJUST to open with a 6 dB SINAD signal.
5. If using multimeter, connect the negative lead to J601-9 (A-).
6. Disable Channel Guard.

STEP	METERING POSITION		TUNING CONTROL	METER READING	PROCEDURE
	GE Test Set	Multimeter - at J601-9			
					FM DETECTOR
1.	A (FM DET)	Pin 2	L603	0.38 Volt	With no signal applied, adjust L603 for a meter reading of approximately 0.38 Volt.
					OSCILLATOR-MULTIPLIER
2.	C (MULT-1)	Pin 3	C406	Maximum	Tune C406 for maximum meter reading.
3.			C411, C416, C306, C307	See Procedure	Preset C411 and C416 to a position similar to C406. Next, preset C306 and C307 fully counterclockwise (minimum capacity).
4.	D (MULT-2)	Pin 4	C411, C416, C406	See Procedure	Tune C411 and C416 for maximum meter reading. Next, retune C406, C411 and C416 for maximum meter reading, then, carefully dip C306 and tune C307 for maximum meter reading. Do NOT readjust C306 and C307.
					RF SELECTIVITY
5.	B (IF AMP)	Pin 1	C502	Maximum	Apply an on-frequency signal in the hole adjacent to C305 and tune C502 for maximum meter reading.
6.	B (IF AMP)	Pin 1	C305	Maximum	Apply an on-frequency signal in the hole adjacent to C304, keeping the signal below saturation. Then tune C305 for maximum meter reading.
7.	B (IF AMP)	Pin 1	C304	Maximum	Apply an on-frequency signal in the hole adjacent to C303, keeping the signal below saturation. Then tune C304 for maximum meter reading.
8.	B (IF AMP)	Pin 1	C303	Maximum	Apply an on-frequency signal in the hole adjacent to C302, keeping the signal below saturation. Then tune C303 for maximum meter reading.
9.	B (IF AMP)	Pin 1	C302 and C301	Maximum	Apply an on-frequency signal to the antenna jack, keeping the signal below saturation. Then tune C302 and C301 for maximum meter reading.
10.	B (IF AMP)	Pin 1	C502, C301 thru C305 (and T2301 if present)	Maximum	Apply an on-frequency signal to the antenna jack, keeping the signal below saturation. Then tune C502 and C301 through C305 for maximum meter reading. In receivers with the UHS preamplifier, also tune T2301 for maximum meter reading.
11.	B (IF AMP)	Pin 1	C502, C301 thru C305 (and T2301 if present)	Maximum	Apply an on-frequency signal to the antenna jack and slightly tune C502 and C301 through C305 (and T2301 if present) for best quieting sensitivity.
12.			L603 R608	See Procedure	Remove the Test Set metering plug from J601. Apply a 1000 microvolt signal with 1 kHz modulation and 3.0 kHz deviation to the antenna jack. Tune L603 for maximum voltage at 1 kHz and adjust R608 for 1 Volt RMS measured with a VTVM at P903-1 (VOL/SQ HI) and P903-6 (A-).

ALIGNMENT PROCEDURE

STEP	METERING POSITION		TUNING CONTROL	METER READING	PROCEDURE
	GE Test Set	Multimeter - at J601-9			
					[illegible] R & IF
					T[illegible] mixer and IF circuits have been aligned at the factory and will normally require no further adjustment. If adjustment is necessa[illegible] the procedure outlined in Step 13. NOTE Refer to DATAFILE BULLETIN 1000-6 (IF Alignment of Two-Way Radio FM Receivers) for helpful suggestions on how to determine when IF Alignment is required.
13.			L505, L520, L521 and C521 		Connect scope, signal generator, and probe as shown in Figure 2. [illegible] generator level for 3 to 5 µV and modulate with 10 kHz at 20 Hz [illegible] J601-1 and A-, tune L505, L520, L521 and C521. for double [illegible] scope pattern.
14.				See Procedure	Check to see that modulation acceptance bandwidth is greater than ±6.5 kHz
					SQUELCH ADJUST
15.				30°	Set SQUELCH ADJUST control (R953) to open with a 6 dB SINAD signal (Approximately 30° counterclockwise of critical squelch position).

STEP 1 - QUICK CHECKS

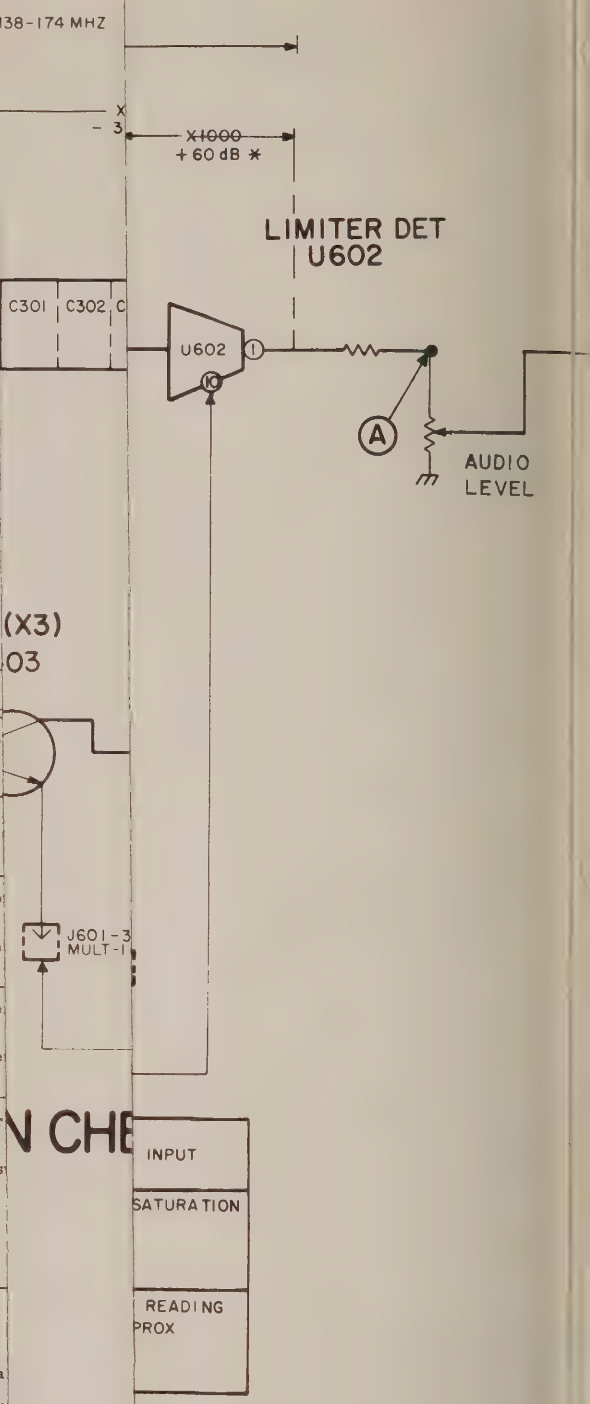
TEST SET CHECKS

These checks are typical voltage readings measured with GE Test Set Model 4EX3A11 in the Test 1 position, or Model 4EX8K12 in the 1-Volt position.

Metering Position	Reading With No Signal In	Reading with 8 Micro-volt Unmodulated
A (FM DET)	0.35 to 0.50 VDC	
B (IF Amp)		0.1 VDC
C (Mult-1)	0.45 VDC	
D (Mult-2)	0.1 VDC	
J (Reg. +10 Volts at System Metering jack)	+10 VDC	

SYMPTOM CHECKS

SYMPTOM	PROCEDURE
NO SUPPLY VOLTAGE	● Check power connections and continuity of supp and check fuse. If fuse is blown, check recei short circuits.
NO REGULATED 10-VOLTS	● Check the 12-Volt supply. Then check 10-Volt circuit. (See Troubleshooting Procedure for 1 Regulator).
LOW IF READING	● Check supply voltages and then check oscillato at J601-3 & 4 as shown in STEP 2. ● Make SIMPLIFIED VTVM GAIN CHECKS from Mixer th Limiter Detector stage as shown in STEP 2.
LOW OSCILLATOR/MULTIPLIER READINGS	● Check alignment of Oscillator/Multiplier. (Re End Alignment Procedure). ● Check voltage readings of Oscillator/Multiplie Q403, Q404).
LOW RECEIVER SENSITIVITY	● Check Front End Alignment. (Refer to Receiver Procedure). ● Check antenna connections, cable and antenna s ● Check Oscillator injection voltage. ● Check voltage readings of Mixer and IF Amp. ● Make SIMPLIFIED GAIN CHECKS (STEP 2).
IMPROPER SQUELCH OPERATION	● Check voltages on Schematic Diagram. ● Make gain and waveform checks with noise. ● Make gain and waveform checks with 6 kHz signa ● Check discrete components in the squelch circu ● Replace U901.
LOW OR DISTORTED AUDIO	● Check voltages on Schematic Diagram. ● Make gain and waveform checks. ● Check receiver and alignment and FM Detector o ● Check Audio Transistors and other discrete com



(RC-2912B)

TROUBLESHOOTING PROCEDURE

138—174 MHz MASTR EXECUTIVE II RECEIVER

TEST PROCEDURES

These Test Procedures are designed to help you to service a receiver that is operating---but not properly. The problems encountered could be low power, poor sensitivity, distortion, limiter not operating properly, and low gain. By following the sequence of test steps starting with Step 1, the defect can be quickly localized. Once the defective stage is pin-pointed, refer to the "Service Check" listed to correct the problem. Additional corrective measures are included in the Troubleshooting Procedure. Before starting with the Receiver Test Procedures, be sure the receiver is tuned and aligned to the proper operating frequency.

TEST EQUIPMENT REQUIRED

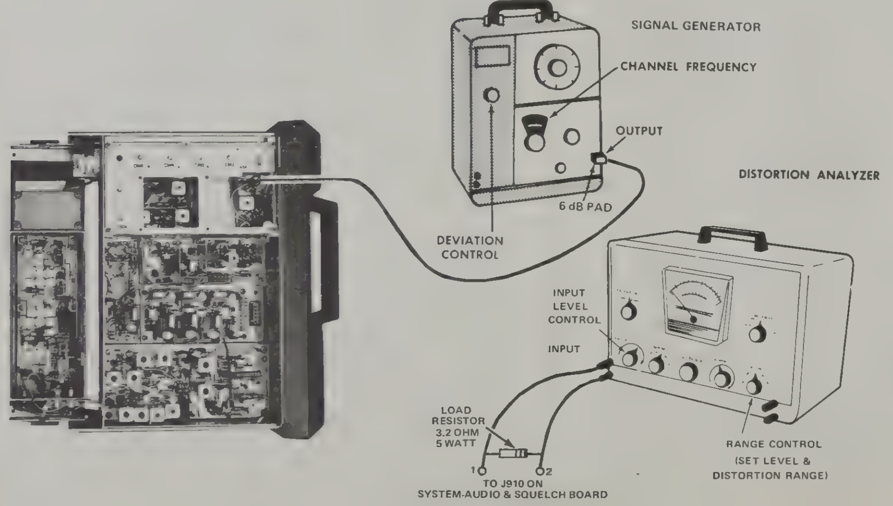
- Distortion Analyzer similar to:

  Heath IM-12
- Signal Generator similar to:

  Measurements 803
- 6-dB attenuation pad, and 3.2-ohm, 5-Watt resistor

PRELIMINARY ADJUSTMENTS

1. Connect the test equipment to the receiver as shown for all steps of the receiver Test Procedure.
2. Turn the SQUELCH control fully clockwise for all steps of the Test Procedure.
3. Turn on all of the equipment and let it warm up for 20 minutes.


SIGNAL GENERATOR
CHANNEL FREQUENCY
OUTPUT
DISTORTION ANALYZER
6 dB PAD
DEVIATION CONTROL
INPUT LEVEL CONTROL
INPUT
LOAD RESISTOR 3.2 OHM 5 WATT
1
2
TO J910 ON SYSTEM-AUDIO & SQUELCH BOARD
RANGE CONTROL (SET LEVEL & DISTORTION RANGE)

STEP 1
AUDIO POWER OUTPUT AND DISTORTION
TEST PROCEDURE

Measure Audio Power Output as follows:

A. Apply a 1,000-microvolt, on-frequency test signal modulated by 1,000 hertz with ±3.0 kHz deviation to antenna jack A301-J1.

B. With 5-Watt Speaker:

Disconnect speaker and connect a 3.2-ohm, 5-Watt load resistor from J910-1 (Speaker Hi) to J910-2. Connect the Distortion Analyzer input across the resistor as shown.

OR

With Handset:

Lift the handset off of the hookswitch. Connect the Distortion Analyzer input from J910-1 to J910-2.

C. Adjust the VOLUME control for 5-Watt output using the Distortion Analyzer as a VTVM (4 VRMS).

D. Make distortion measurements according to manufacturer's instructions. Reading should be less than 5%. If the receiver sensitivity is to be measured, leave all controls and equipment as they are.

SERVICE CHECK

If the distortion is more than 5%, or maximum audio output is less than 5-Watts, make the following checks:

E. Battery and regulator voltage---low voltage will cause distortion. (Refer to Receiver Schematic Diagram for voltages.)

F. Audio Gain (Refer to Receiver Troubleshooting Procedure.)

G. FM Detector Adjustment (Refer to Receiver Alignment on reverse side of page).

STEP 2
USABLE SENSITIVITY
(12-dB SINAD)

If STEP 1 checks out properly, measure the receiver sensitivity as follows:

A. Apply a 1000-microvolt, on-frequency signal modulated by 1000 Hz with 3.0-kHz deviation to A301-J1.

B. Place the RANGE switch on the Distortion Analyzer in the 200 to 2000-Hz distortion range position (1000-Hz filter in the circuit). Tune the filter for minimum reading or null on the lowest possible scale (100%, 30%, etc.)

C. Place the RANGE switch to the SET LEVEL position (filter out of the circuit) and adjust the input LEVEL control for a +2 dB reading on a mid range (30%).

D. While reducing the signal generator output, switch the RANGE control from SET LEVEL to the distortion range until a 12-dB difference (+2 dB to -10 dB) is obtained between the SET LEVEL and distortion range positions (filter out and filter in).

E. The 12-dB difference (Signal plus Noise and Distortion to noise plus distortion ratio) is the "usable" sensitivity level. The sensitivity should be less than rated 12 dB SINAD specifications with an audio output of at least 2.5 Watts (2.8 Volts RMS across the 3.2-ohm receiver load using the Distortion Analyzer as a VTVM).

F. Leave all controls as they are and all equipment connected if the Modulation Acceptance Bandwidth test is to be performed.

SERVICE CHECK

If the sensitivity level is more than rated 12 dB SINAD, check the alignment of the RF stages as directed in the Alignment Procedure, and make the gain measurements as shown on the Troubleshooting Procedure.

STEP 3
MODULATION ACCEPTANCE BANDWIDTH (IF BANDWIDTH)

If STEPS 1 and 2 check out properly, measure the bandwidth as follows:

A. Set the Signal Generator output for twice the microvolt reading obtained in the 12-dB SINAD measurement.

B. Set the RANGE control on the Distortion Analyzer in the SET LEVEL position (1000-Hz filter out of the circuit), and adjust the input LEVEL control for a +2 dB reading on the 30% range.

C. While increasing the deviation of the Signal Generator, switch the RANGE control from SET LEVEL to distortion range until a 12-dB difference is obtained between the SET LEVEL and distortion range readings (from +2 dB to -10 dB).

D. The deviation control reading for the 12-dB difference is the Modulation Acceptance Bandwidth of the receiver. It should be more than 6.5 kHz.

SERVICE CHECK

If the Modulation Acceptance Bandwidth test does not indicate the proper width, make gain measurements as shown on the Receiver Troubleshooting Procedure.

STEP 1 - QUICK CHECKS

TEST SET CHECKS

These checks are typical voltage readings measured with GE Test Set Model 4EX3A11 in the Test 1 position, or Model 4EX8K12 in the 1-Volt position.

Metering Position	Reading With No Signal In	Reading with 8 Microvolt Unmodulated
A (FM DET)	0.35 to 0.50 VDC	
B (IF Amp)		0.1 VDC
C (Mult-1)	0.45 VDC	
D (Mult-2)	0.1 VDC	
J (Reg. +10 Volts at System Metering jack)	+10 VDC	

SYMPTOM CHECKS

SYMPTOM	PROCEDURE
NO SUPPLY VOLTAGE	● Check power connections and continuity of supply leads, and check fuse. If fuse is blown, check receiver for short circuits.
NO REGULATED 10-VOLTS	● Check the 12-Volt supply. Then check 10-Volt regulator circuit. (See Troubleshooting Procedure for 10-Volt Regulator).
LOW IF READING	● Check supply voltages and then check oscillator readings at J601-3 & 4 as shown in STEP 2. ● Make SIMPLIFIED VTVM GAIN CHECKS from Mixer through Limiter Detector stage as shown in STEP 2.
LOW OSCILLATOR/MULTIPLIER READINGS	● Check alignment of Oscillator/Multiplier. (Refer to Front End Alignment Procedure). ● Check voltage readings of Oscillator/Multiplier (Q402, Q403, Q404).
LOW RECEIVER SENSITIVITY	● Check Front End Alignment. (Refer to Receiver Alignment Procedure). ● Check antenna connections, cable and antenna switch. ● Check Oscillator injection voltage. ● Check voltage readings of Mixer and IF Amp. ● Make SIMPLIFIED GAIN CHECKS (STEP 2).
IMPROPER SQUELCH OPERATION	● Check voltages on Schematic Diagram. ● Make gain and waveform checks with noise. ● Make gain and waveform checks with 6 kHz signal. ● Check discrete components in the squelch circuit. ● Replace U901.
LOW OR DISTORTED AUDIO	● Check voltages on Schematic Diagram. ● Make gain and waveform checks. ● Check receiver and aligment and FM Detector output. ● Check Audio Transistors and other discrete components.

STEP 4-VOLTAGE RATIO READINGS

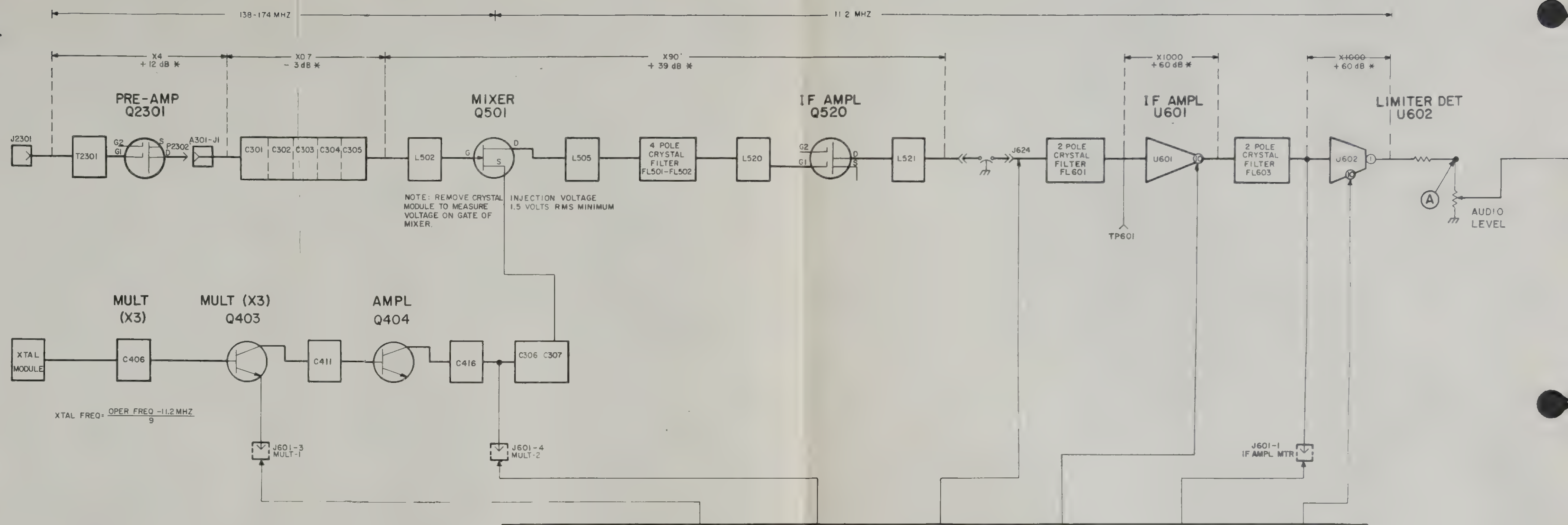
EQUIPMENT REQUIRED:
1. RF VOLTMETER
2. SIGNAL ON RECEIVER FREQUENCY (BELOW SATURATION). USE 1000 HERTZ SIGNAL WITH 3.0 KHz DEVIATION.

PROCEDURE:
1. APPLY PROBE TO INPUT OF STAGE (FOR EXAMPLE, SOURCE OF RF AMP) PEAK RESONANT CIRCUIT OF STAGE BEING MEASURED AND TAKE VOLTAGE READING (E_1).
2. MOVE PROBE TO INPUT OF FOLLOWING STAGE (MIXER). REPEAK FIRST RESONANT CIRCUIT THEN PEAK CIRCUIT BEING MEASURED AND TAKE READING (E_2).
3. CONVERT READINGS BY MEANS OF THE FOLLOWING FORMULA.

$$\text{VOLTAGE RATIO} = \frac{E_2}{E_1}$$

4. CHECK RESULTS WITH TYPICAL VOLTAGE RATIOS SHOWN ON DIAGRAM

* DIFFERENCE BETWEEN INPUT AND OUTPUT READINGS ON dB SCALE OF RF VOLTMETER. NOT ACTUAL POWER GAIN.


138-174 MHZ
11.2 MHZ
X4
+ 12 dB *
X0.7
- 3 dB *
X90
+ 39 dB *
X1000
+ 60 dB *
X1000
+ 60 dB *
PRE-AMP
Q2301
MIXER
Q501
IF AMPL
Q520
IF AMPL
U601
LIMITER DET
U602
J2301
T2301
G2
G1
S
D
P2302
A301-J1
C301
C302
C303
C304
C305
L502
G
D
S
L505
4 POLE CRYSTAL FILTER FL501-FL502
L520
G2
G1
D
S
L521
J624
2 POLE CRYSTAL FILTER FL601
U601
10
TP601
2 POLE CRYSTAL FILTER FL603
U602
1
10
A
AUDIO LEVEL
MULT
(X3)
MULT (X3)
Q403
AMPL
Q404
XTAL MODULE
C406
C411
C416
C306 C307
J601-3
MULT-1
J601-4
MULT-2
J601-1
IF AMPL MTR

NOTE: REMOVE CRYSTAL MODULE TO MEASURE VOLTAGE ON GATE OF MIXER.

INJECTION VOLTAGE 1.5 VOLTS RMS MINIMUM

XTAL FREQ = $\frac{\text{OPER FREQ} - 11.2\text{ MHZ}}{9}$

STEP 2-SIMPLIFIED GAIN CHECKS

EQUIPMENT REQUIRED
1. AC & DC VOLTMETER
2. SIGNAL GENERATOR
3. R F VOLTMETER

PRELIMINARY STEPS:
1. SET VOLUME CONTROL FOR 4.0 VOLTS ACROSS 3.2-OHM LOAD. IF THIS CANNOT BE OBTAINED, SET TO APPROX. 70% OF MAX ROTATION.
2. SET SQUELCH CONTROL FULLY COUNTERCLOCKWISE.
3. RECEIVER SHOULD BE PROPERLY ALIGNED.
4. CONNECT METER BETWEEN A- AND POINTS INDICATED BY ARROW.

SIGNAL APPLIED TO A301-J1	NONE	NONE	UNMODULATED	UNMODULATED	UNMODULATED	NO SIGNAL INPUT
PROCEDURE			SET GENERATOR OUTPUT AT 1000 MICROVOLTS TO RECEIVE FREQUENCY	RESET GENERATOR OUTPUT TO ZERO, THE INCREASE OUTPUT UNTIL U601 SATUATED WITH RF VOLTMETER	RESET GENERATOR OUTPUT FROM ZERO TO 40 MICROVOLTS (10 MICROVOLTS WITH PREAMP)	SHOULD BE IN SATURATION AT ALL TIMES
READING	VOLTMETER READING SHOULD BE APPROX. 0.5VDC	VOLTMETER READING SHOULD BE APPROX 0.2VDC	RF VOLTMETER READING SHOULD BE APPROX 200 MILLIVOLTS	GENERATOR OUTPUT SHOULD BE APPROX 40 MICROVOLTS (10 MICROVOLTS WITH PREAMP)	VOLTMETER READING SHOULD BE APPROX 0.54VDC	RF VOLTMETER READING SHOULD BE APPROX 0.6V RMS

(RC-2912B)

TROUBLESHOOTING PROCEDURE

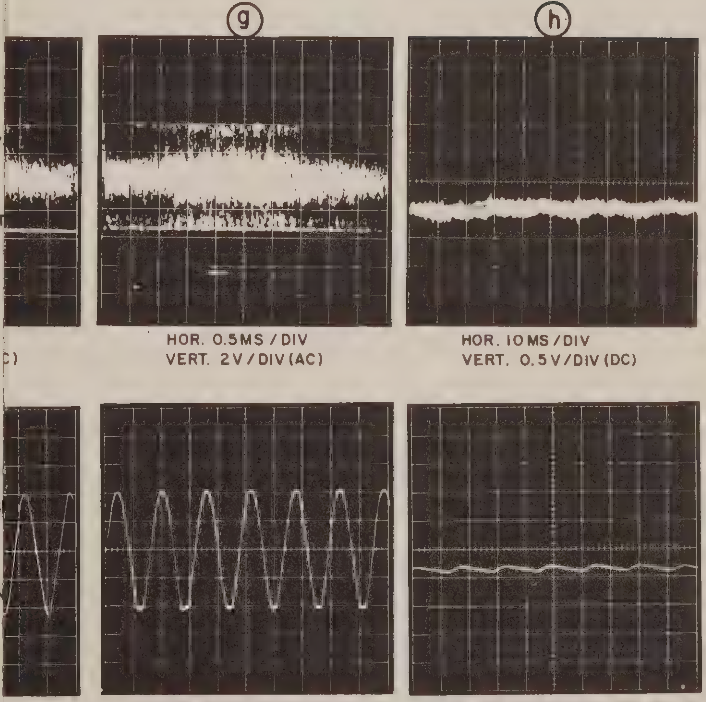
138—174 MHz MASTR EXECUTIVE II RECEIVER

UDIC

EQUIPMENT
1. OSCILLOS
INDICATE
2. SIGNAL G
3. 6 KHz GE

ELCH WAV
NOISE)
RF
SQUELCH CONT
RITICAL.

H 6KHz SIG
V RF.
Hz MOD
Hz DEV.
T SQUELCH CON
ITICAL (TP901
OVDC.)



C)

HOR. 0.5MS / DIV
VERT. 2V / DIV (AC)

HOR. 10MS / DIV
VERT. 0.5V / DIV (DC)

C)

HOR. 0.1MS / DIV
VERT. 1V / DIV (AC)

HOR. 0.1MS/ DIV
VERT. 0.5V / DIV (DC)

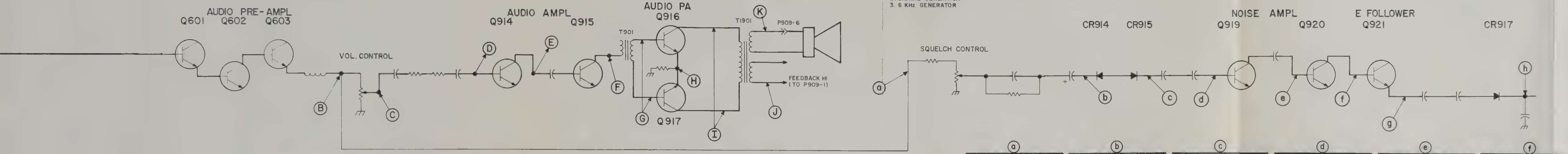
(RC-2912B)

TROUBLESHOOTING PROCEDURE

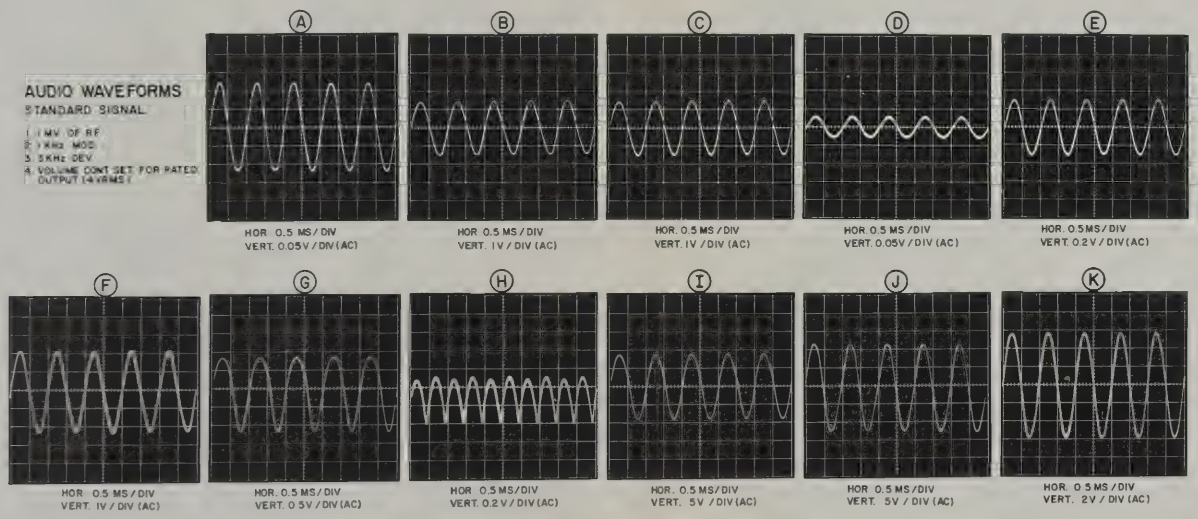
138—174 MHz MASTR EXECUTIVE II RECEIVER

STEP 3-AUDIO & SQUELCH WAVEFORMS

EQUIPMENT REQUIRED
1. OSCILLOSCOPE CONNECTED BETWEEN A- AND POINTS INDICATED BY ARROW
2. SIGNAL GENERATOR
3. 6 KHz GENERATOR

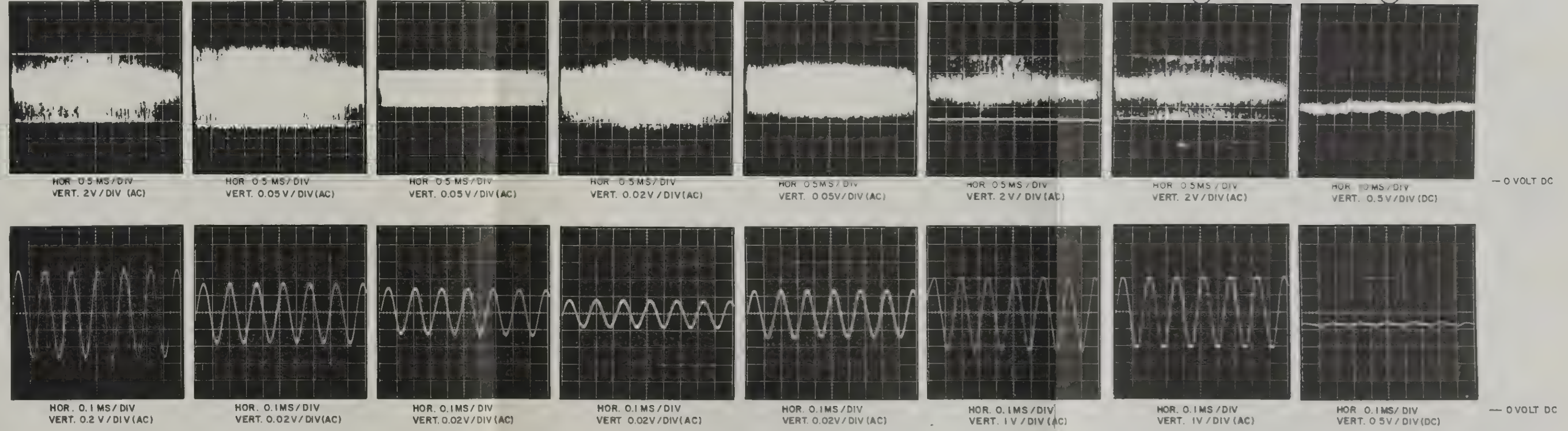

AUDIO PRE-AMPL
Q601
Q602
Q603
VOL. CONTROL
AUDIO AMPL
Q914
Q915
AUDIO PA
Q916
Q917
T901
T1901
P909-6
FEEDBACK HI (TO P909-1)
A
B
C
D
E
F
G
H
I
J
K
SQUELCH CONTROL
CR914
CR915
NOISE AMPL
Q919
Q920
E FOLLOWER
Q921
CR917
a
b
c
d
e
f
g
h

AUDIO WAVEFORMS
STANDARD SIGNAL
1. 1 MV OF RF
2. 1 KHz MOD.
3. 3 KHz DEV.
4. VOLUME CONT SET FOR RATED OUTPUT (4 VRMS)



SQUELCH WAVEFORMS
(WITH NOISE)
1. NO RF
2. SET SQUELCH CONTROL TO CRITICAL

(WITH 6KHz SIGNAL)
1. 1 MV RF.
2. 6KHz MOD
3. 3KHz DEV
4. SET SQUELCH CONTROL FOR CRITICAL (TP901 JUST FALLS TO OVDC.)



(RC-2912B)

TROUBLESHOOTING PROCEDURE

138—174 MHz MASTR EXECUTIVE II RECEIVER

MOBILE RADIO

LBI4980C
(DF1107)
(DF1118)
(IMTS)

MAINTENANCE MANUAL

138—174 MHz RF ASSEMBLY 19D416693G1, G2, G7, G8 AND MIXER/IF BOARD 19C320153G1

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SCHEMATIC DIAGRAMS

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Mixer/IF Board 5

PARTS LIST & PRODUCTION CHANGES 6

DESCRIPTION

The RF Assembly uses five tuned helical resonators to provide front end RF selectivity with no gain. A UHS pre-amplifier assembly is available that can be used with the receiver to improve sensitivity.

The Mixer/IF board (MIF) uses the RF signal from the RF Assembly and the mixer injection frequency from the oscillator multiplier board to generate the IF frequency.

CIRCUIT ANALYSIS

RF ASSEMBLY

RF PRE-AMPLIFIER (Optional)

The pre-amplifier is present only in UHS receivers, and uses a dual-gate Field Effect Transistor (FET) to provide approximately 12 dB gain.

RF from the antenna is coupled through T2301 to Gate 1 of pre-amplifier Q2301. The primary of T2301 provides a 50 ohm input impedance. The amplified output at the drain terminal of Q2301 is coupled through T2302 and connected to J1 on Antenna Input board A301 through cable W2302. T2302 is tapped to provide a 50 ohm output impedance. P2301 connects to J501 on the MIF board for the regulated +10 Volt supply voltage.

ANTENNA INPUT A301/A301B

An RF signal from the antenna or UHS pre-amplifier is applied to A301 which provides an AC ground between vehicle ground and receiver A-. Resistor R1 prevents a static charge from building up on the vehicle antenna. The output of A301 is coupled through five high Q helical resonators that provide the front end RF selectivity. The helicals are tuned to the incoming frequency by C301 through C305.

MIXER-IF

MIXER & CRYSTAL FILTER

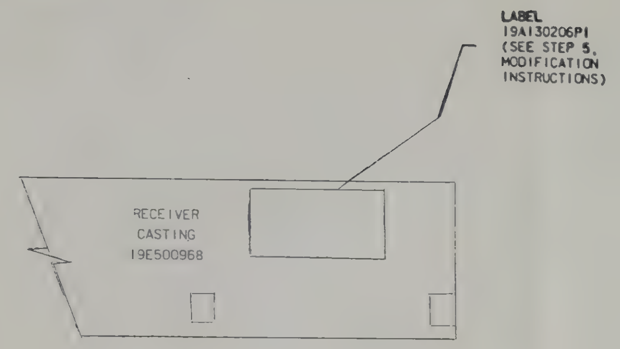
The mixer uses a FET (Q501) as the active device. The FET mixer provides a high input impedance, high power gain, and an output relatively free of harmonics (low in intermodulation products).

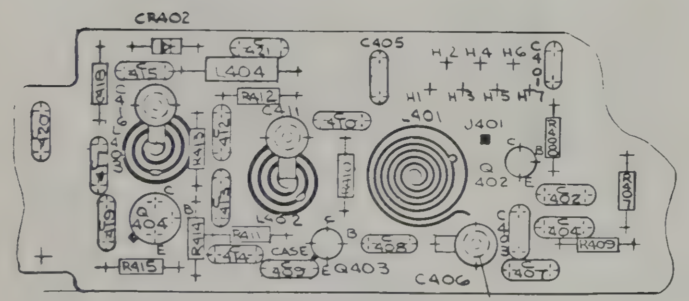
In the mixer stage, RF from the helical resonators is coupled through L502 and C502 which matches the RF output to the gate of mixer Q501. Injection voltage from the multiplier-selectivity stages is inductively coupled through L501 to the source of the mixer. The 11.2 MHz mixer IF output signal is coupled from the drain of Q501 through a tuned circuit (L505 and C505) which matches the mixer output to the input of the four-pole monolithic crystal filter. The highly-selective crystal filter (FL501 and FL502) provides the first portion of the receiver IF selectivity. The output of the filter is coupled through impedance-matching network L520 and C523 to the IF amplifier.

Service Note: Variable capacitor C521 does not require adjustment when performing normal alignment. If the four-pole monolithic crystal filter is replaced, then adjustment of C521 is necessary for optimum IF response.

IF AMPLIFIER

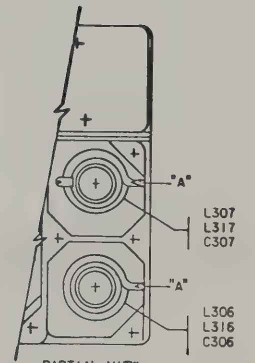
IF amplifier Q520 is a dual-gate FET. The filter output is applied to Gate 1 of the amplifier, and the output is taken from the drain. The biasing on Gate 2 and the drain load determines the gain of the stage. The amplifier provides approximately 20 dB of IF gain.


LABEL
19A130206P1
(SEE STEP 5,
MODIFICATION
INSTRUCTIONS)
RECEIVER
CASTING
19E500968

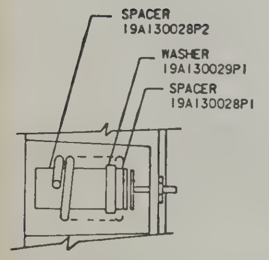

CRA02
C405
L404
R418
R412
C411
C401
H2 H4 H6
H1 H3 H5 H7
L401
J401
Q402
R408
R407
C402
C403
C404
R409
C407
C406
Q403
CASE
C408
C409
R411
R414
R415
L402
Q404
R413
R410
C420
C,B,E

PARTIAL VIEW
OSC/MULT BD 19C321740

HIGH BAND HIGH SIDE INJECTION WITH OSC/MULT BOARD 19C321740


"A"
L307
L317
C307
"A"
L306
L316
C306

PARTIAL VIEW
R.F. CKT PL19D416693


SPACER
19A130028P2
WASHER
19A130029P1
SPACER
19A130028P1

VIEW AT "A"
(PARTIAL)
(TYP TWO PLACES)

③ MODIFICATION INSTRUCTIONS FOR HIGH BAND HIGH SIDE INJECTION APPLYING 19A130045G1 OR G2 KIT

1. ON OSC/MULT. BD. 19C321740G1 (LOW SPLIT) REMOVE C412 & C417. REPLACE C407 WITH C2311 (12pf, NPO), REPLACE C419 WITH C2312 (3pf, NPO). REPLACE C420 WITH C2313 (5pf, NPO). DISCARD C2314.

   ON OSC/MULT. BD. 19C321740G2 (HIGH SPLIT), REMOVE C407 AND C412. REPLACE C419 WITH C2312 (3pf, NPO), REPLACE C420 WITH C2314 (4pf, NPO). DISCARD C2311, and C2313.

   SOLDER ALL ELECTRICAL CONNECTIONS. C2301 THRU C2314 ARE PART OF MOD KIT 19A130045G1, C2311 THRU C2314 ONLY—G2.

2. MODIFY RF. CKT ASM PL19D416693 BY ADDING 19A130028P1 SPACER, 19A130029P1 WASHER, AND 19A130028P2 SPACER AS SHOWN TO L306 & L307 (LOW SPLIT) OR L316, & L317 (HIGH SPLIT). SLIDE SPACERS, & WASHER ON CERAMIC POST FROM TOP IN ORDER SHOWN. THESE ITEMS ARE PART OF MOD KIT PL19A130045G1 AND G2.

3. IN APPLICATION OF THIS KIT THE CRYSTAL OSCILLATOR FREQUENCY MUST BE CHANGED PER THE FOLLOWING FORMULA:

   $$F_x = \frac{F_o + 11.2}{9}$$

4. MARK ALL OSC/MULT. BD'S 19C321740 WITH A BLUE COLOR DOT IN THE AREA OF THE PL DRAWING NO. PER 19A115740P1.

   MARK ALL RECEIVER CASTINGS WITH A BLUE COLOR DOT IN THE AREA OF THE PL DRAWING NO. PER 19A115740P1.

5. APPLY LABEL (19A130206P1) TO SIDE OF RECEIVER CASTING.

6. TEST AND ALIGN PER NORMAL PROCEDURE WITH THE FOLLOWING EXCEPTION:
   PRE-ADJUST C411 AND C416 TO MINIMUM CAPACITY, THEN TUNE IN SLOWLY.

(19C320883, Sh. 3, Rev. 3)

MOBILE RADIO

LBI4980C
(DF1107)
(DF1118)
(IMTS)

MAINTENANCE MANUAL

138—174 MHz RF ASSEMBLY 19D416693G1, G2, G7, G8 AND MIXER/IF BOARD 19C320153G1

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DESCRIPTION

The RF Assembly uses five tuned helical resonators to provide front end RF selectivity with no gain. A UHS pre-amplifier assembly is available that can be used with the receiver to improve sensitivity.

The Mixer/IF board (MIF) uses the RF signal from the RF Assembly and the mixer injection frequency from the oscillator multiplier board to generate the IF frequency.

CIRCUIT ANALYSIS

RF ASSEMBLY

RF PRE-AMPLIFIER (Optional)

The pre-amplifier is present only in UHS receivers, and uses a dual-gate Field Effect Transistor (FET) to provide approximately 12 dB gain.

RF from the antenna is coupled through T2301 to Gate 1 of pre-amplifier Q2301. The primary of T2301 provides a 50 ohm input impedance. The amplified output at the drain terminal of Q2301 is coupled through T2302 and connected to J1 on Antenna Input board A301 through cable W2302. T2302 is tapped to provide a 50 ohm output impedance. P2301 connects to J501 on the MIF board for the regulated +10 Volt supply voltage.

ANTENNA INPUT A301/A301B

An RF signal from the antenna or UHS pre-amplifier is applied to A301 which provides an AC ground between vehicle ground and receiver A-. Resistor R1 prevents a static charge from building up on the vehicle antenna. The output of A301 is coupled through five high Q helical resonators that provide the front end RF selectivity. The helicals are tuned to the incoming frequency by C301 through C305.

MIXER-IF

MIXER & CRYSTAL FILTER

The mixer uses a FET (Q501) as the active device. The FET mixer provides a high input impedance, high power gain, and an output relatively free of harmonics (low in intermodulation products).

In the mixer stage, RF from the helical resonators is coupled through L502 and C502 which matches the RF output to the gate of mixer Q501. Injection voltage from the multiplier-selectivity stages is inductively coupled through L501 to the source of the mixer. The 11.2 MHz mixer IF output signal is coupled from the drain of Q501 through a tuned circuit (L505 and C505) which matches the mixer output to the input of the four-pole monolithic crystal filter. The highly-selective crystal filter (FL501 and FL502) provides the first portion of the receiver IF selectivity. The output of the filter is coupled through impedance-matching network L520 and C523 to the IF amplifier.

Service Note: Variable capacitor C521 does not require adjustment when performing normal alignment. If the four-pole monolithic crystal filter is replaced, then adjustment of C521 is necessary for optimum IF response.

IF AMPLIFIER

IF amplifier Q520 is a dual-gate FET. The filter output is applied to Gate 1 of the amplifier, and the output is taken from the drain. The biasing on Gate 2 and the drain load determines the gain of the stage. The amplifier provides approximately 20 dB of IF gain.

The output of Q520 is coupled through impedance matching network L521, and C528 and coupling capacitor C529 and feed-through capacitor C325 to the next IF stage on to the MIF switch in Dual Front End Applications.

Supply voltage for the RF amplifier and MIF board is supplied through feed-through capacitor C326.

GENERAL ELECTRIC COMPANY • MOBILE COMMUNICATIONS DIVISION
WORLD HEADQUARTERS • LYNCHBURG, VIRGINIA 24502 U.S.A.

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U.S.A.

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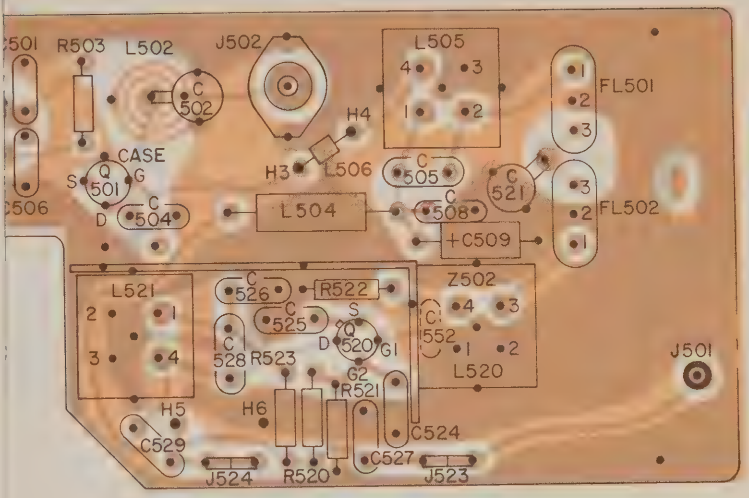
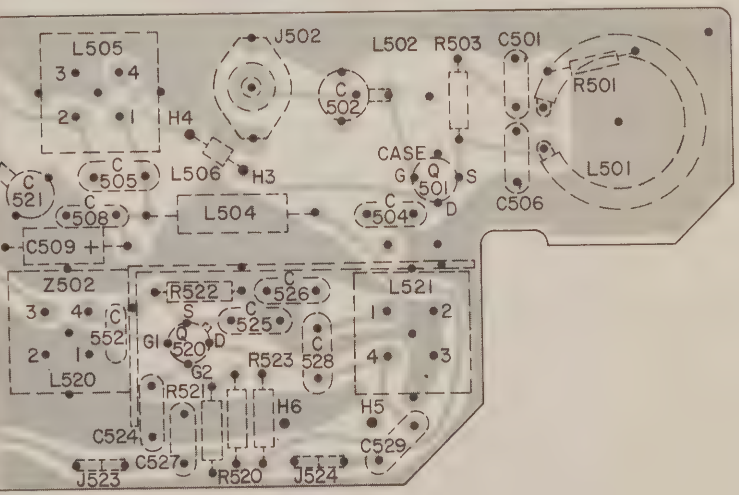
MIXER/IF BOARD

COMPONENT SIDE


C501
R503
L502
J502
L505
FL501
C502
CASE
Q501
S
G
D
H4
H3
L506
C505
C521
C506
C504
L504
C508
FL502
C509
L521
C526
R522
Z502
C525
Q520
C552
C528
R523
G1
G2
R521
L520
J501
H5
H6
C524
C529
C527
J524
R520
J523

(19C321054, Sh. 2, Rev. 1)
(19C321054, Sh. 3, Rev. 0)

SOLDER SIDE


L505
J502
L502
R503
C501
R501
H4
C502
CASE
L501
C521
C505
L506
H3
Q501
C506
C508
L504
C504
C509
Z502
R522
C526
L521
C552
C525
Q520
G1
D
S
G2
R523
C528
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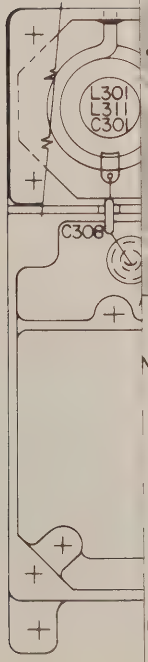
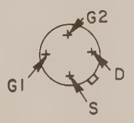
J524

(19C321054, Sh. 2, Rev. 1)


L301
L311
C301
C306

N

Q520, Q2301



EMENT, AND NOT
IS DETERMINING
LEAD IDENTIFICATION.

OUTLINE DIAGRAM

138—174 MHz RF ASSEMBLY AND MIXER/IF BOARD

The output of Q520 is coupled through impedance matching network L521, and C528 and coupling capacitor C529 and feed-through capacitor C325 to the next IF stage on to the MIF switch in Dual Front End Applications.

Supply voltage for the RF amplifier and MIF board is supplied through feed-through capacitor C326.

GENERAL ELECTRIC COMPANY• MOBILE COMMUNICATIONS DIVISION
WORLD HEADQUARTERS• LYNCHBURG, VIRGINIA 24502 U.S.A.

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U.S.A.

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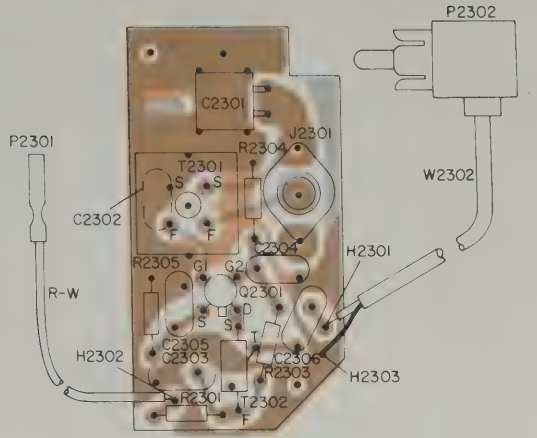
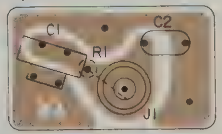
UHS PRE-AMPLIFIER


P2302
P2301
C2301
J2301
R2304
T2301
W2302
C2302
C2304
H2301
R2305
G1
G2
Q2301
R-W
C2305
C2303
H2302
C2306
R2303
H2303
R2301
T2302

(19C320201, Sh. 2, Rev. 1)
(19C320201, Sh. 3, Rev. 1)

A301A ANT INPUT

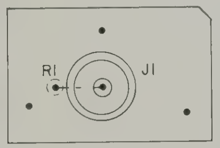
(FLOATING GROUND)



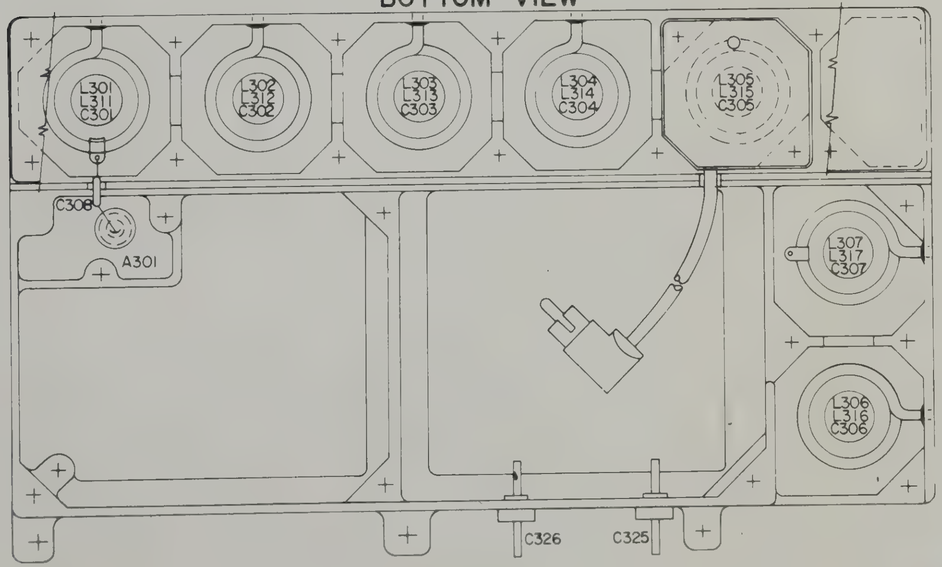
(19B219679, Sh. 2, Rev. 2)
(19B219679, Sh. 3, Rev. 2)

A301B ANT INPUT

(NON-FLOATING GROUND)



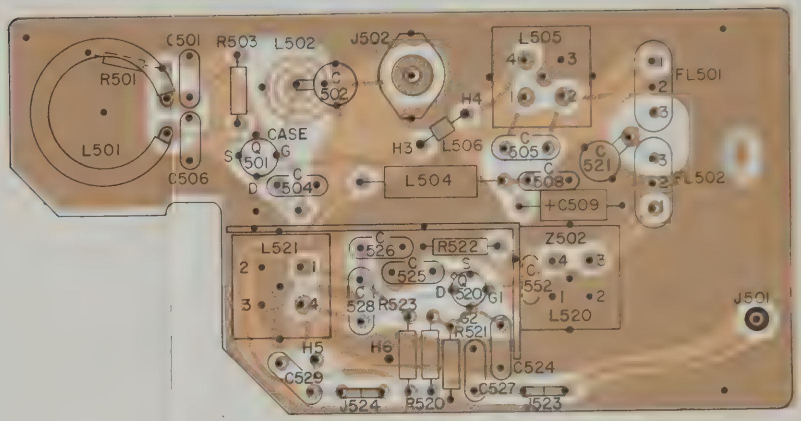
RF ASSEMBLY BOTTOM VIEW


L301 L311 C301
L302 L312 C302
L303 L313 C303
L304 L314 C304
L305 L315 C305
C308
A301
L307 L317 C307
L306 L316 C306
C326
C325

(19D423618, Rev. 2)

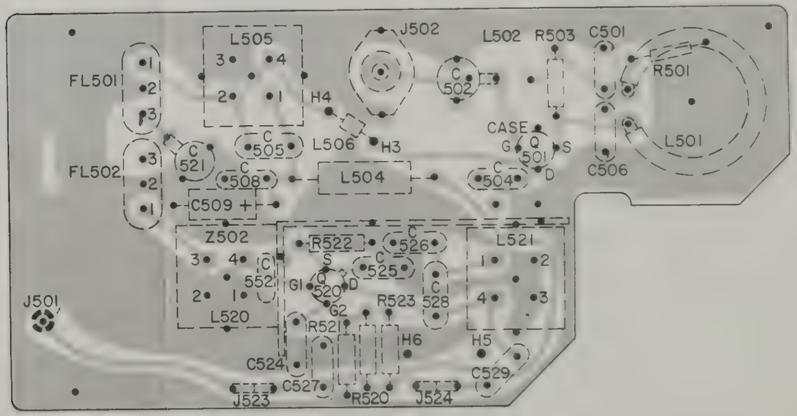
MIXER/IF BOARD

COMPONENT SIDE


C501
R503
L502
J502
L505
FL501
R501
C502
H4
CASE
Q501
L501
H3
L506
C505
C521
C506
C504
L504
C508
FL502
C509
L521
C526
R522
Z502
C525
Q520
C552
C528
R523
L520
J501
R521
H5
H6
C529
C524
C527
J524
R520
J523

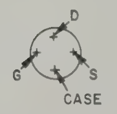
(19C321054, Sh. 2, Rev. 1)
(19C321054, Sh. 3, Rev. 0)

SOLDER SIDE


L505
J502
L502
R503
C501
FL501
C502
R501
H4
CASE
Q501
L501
C505
L506
H3
FL502
C521
C508
L504
C504
C506
C509
Z502
R522
C526
L521
Q520
C525
C552
R523
C528
J501
L520
R521
G2
H6
H5
C524
C527
C529
J523
R520
J524

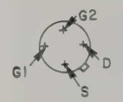
(19C321054, Sh. 2, Rev. 1)

LEAD IDENTIFICATION FOR Q501

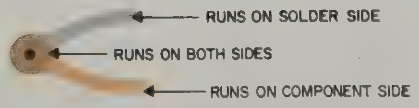


VIEW FROM CASE END

Q520, Q2301

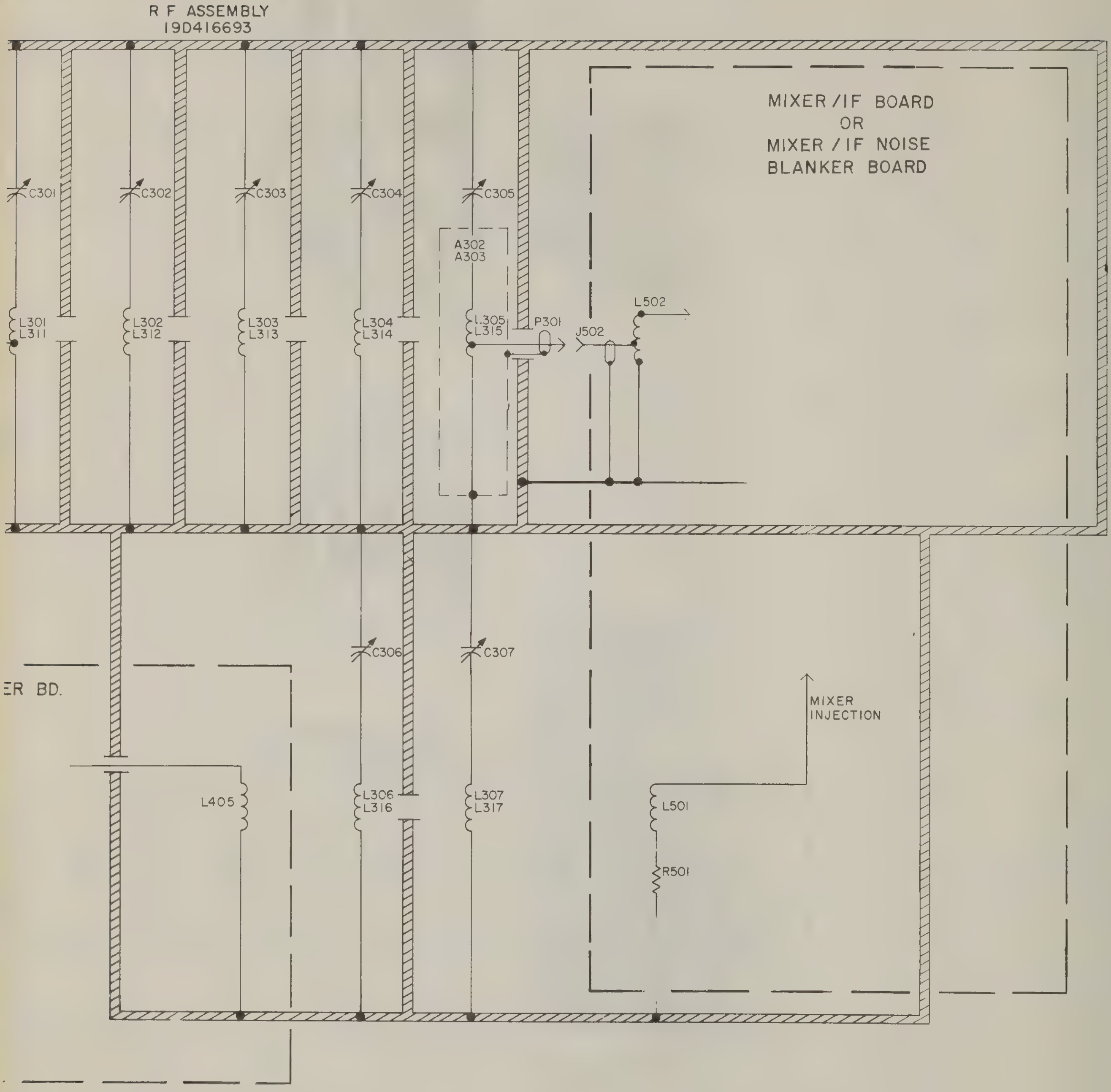


NOTE: LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.


RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE

OUTLINE DIAGRAM

138—174 MHz RF ASSEMBLY
AND MIXER/IF BOARD


R F ASSEMBLY
19D416693
MIXER / IF BOARD
OR
MIXER / IF NOISE
BLANKER BOARD
C301
C302
C303
C304
C305
A302
A303
L301
L311
L302
L312
L303
L313
L304
L314
L305
L315
P301
J502
L502
ER BD.
C306
C307
MIXER
INJECTION
L405
L306
L316
L307
L317
L501
R501

IBLY	FREQ RANGE (MHZ)
REV LTR	
B	138-155
C	150.8-174
–	138-155
–	150.8-174

ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG = 1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H= HENRYS.

IN ORDER, TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.

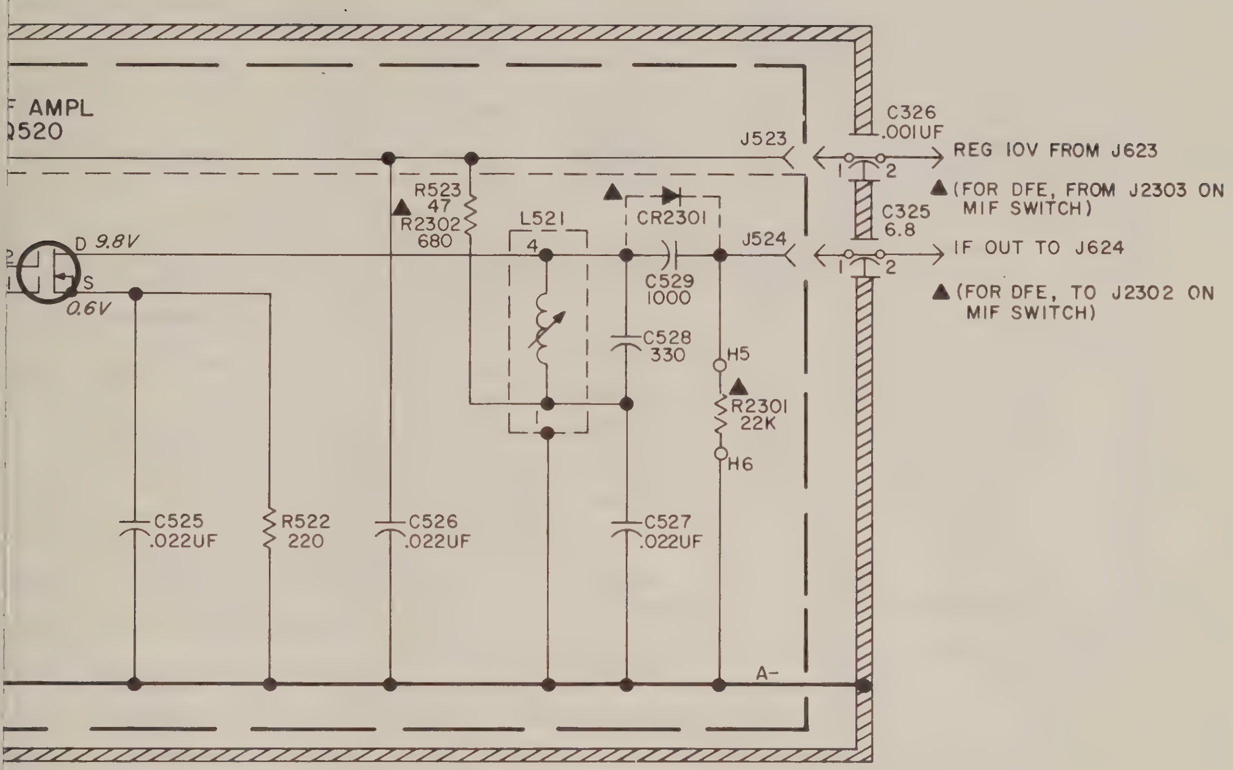
VOLTAGE READINGS

VOLTAGE READINGS ARE TYPICAL READINGS MEASURED TO SYSTEM NEGATIVE (P903-10) WITH TEST SET MODEL 4EX3A11 OR A 20,000 OHM-PER-VOLT METER.

⊥ INDICATES A-

⏚ INDICATES VEHICLE GROUND

(19D423469, Rev. 1)


F AMPL
Q520
D 9.8V
S
0.6V
C525
.022UF
R522
220
C526
.022UF
R523
47
R2302
680
L521
4
CR2301
C529
1000
C528
330
H5
R2301
22K
H6
C527
.022UF
J523
J524
C326
.001UF
C325
6.8
1
2
REG 10V FROM J623
▲(FOR DFE, FROM J2303 ON MIF SWITCH)
IF OUT TO J624
▲(FOR DFE, TO J2302 ON MIF SWITCH)
A-

VOLTAGE READINGS

VOLTAGE READINGS ARE TYPICAL READINGS MEASURED TO SYSTEM NEGATIVE (P903-10) WITH TEST SET MODEL 4EX3A11 OR A 20,000 OHM-PER-VOLT METER.

⊥ INDICATES A-

⏚ INDICATES VEHICLE GROUND

ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG = 1,000,000 OHMS CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.

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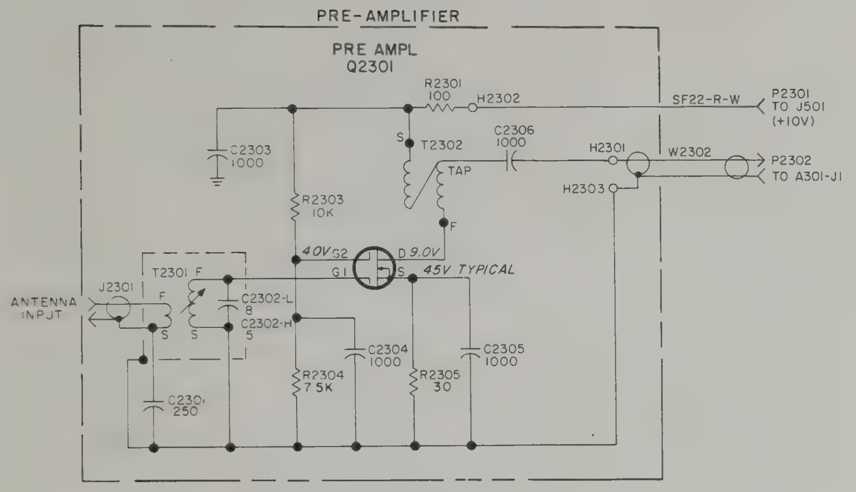
SCHEMATIC DIAGRAM

138—174 MHz MIXER/IF BOARD

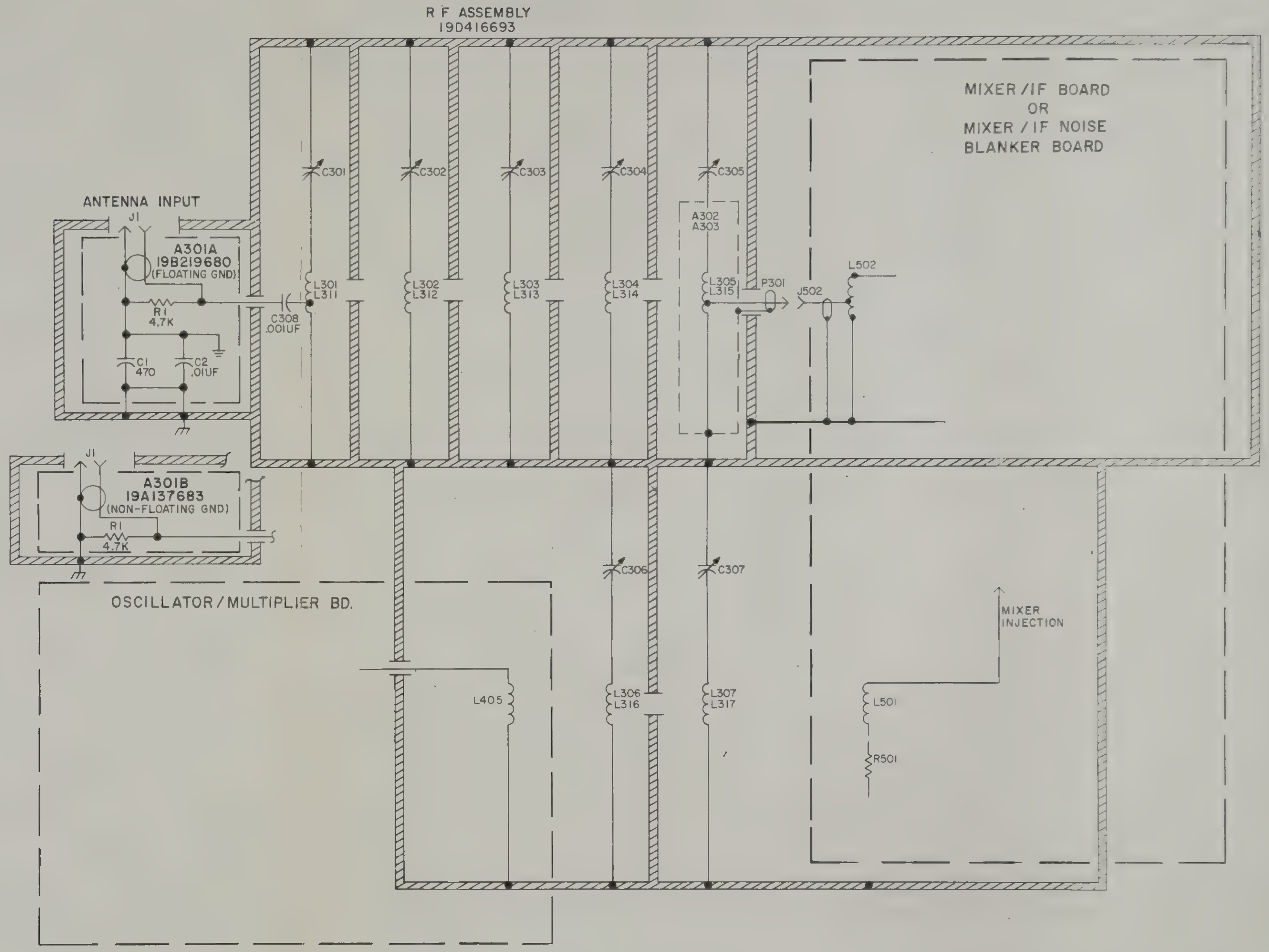

PRE-AMPLIFIER
PRE AMPL
Q2301
R2301
100
H2302
SF22-R-W
P2301
TO J501
(+10V)
C2303
1000
S
T2302
C2306
1000
H2301
W2302
P2302
TO A301-J1
TAP
H2303
R2303
10K
F
40V
G2
D 9.0V
G1
S
45V TYPICAL
ANTENNA
INPUT
J2301
T2301
F
C2302-L
C2302-H
R2304
7.5K
C2304
1000
R2305
30
C2305
1000
C2301
250

SEE APPLICABLE PRODUCTION CHANGE SHEETS IN INSTRUCTION BOOK SECTION DEALING WITH THIS UNIT, FOR DESCRIPTION OF CHANGES UNDER EACH REVISION LETTER

THIS ELEM DIAG APPLIES TO

MODE NO	REV LETTER
PL19C320215G1	B
PL19C320215G2	B

(19B219622, Rev. 5)


R F ASSEMBLY
19D416693
MIXER/IF BOARD
OR
MIXER/IF NOISE
BLANKER BOARD
C301
C302
C303
C304
C305
ANTENNA INPUT
J1
A301A
19B219680
(FLOATING GND)
R1
4.7K
C1
470
C2
.01UF
C308
.001UF
L301
L311
L302
L312
L303
L313
L304
L314
A302
A303
L305
L315
P301
J502
L502
J1
A301B
19A137683
(NON-FLOATING GND)
R1
4.7K
OSCILLATOR/MULTIPLIER BD.
C306
C307
L405
L306
L316
L307
L317
MIXER
INJECTION
L501
R501

ANTENNA INPUT A301		RF ASSEMBLY		FREQ RANGE (MHZ)
	REV LTR		REV LTR	
19B219680G1	-	19D416693G1	B	138-155
19B219680G1	-	19D416693G2	C	150.8-174
19A137683G1	-	19D416693G7	-	138-155
19A137683G1	-	19D416693G8	-	150.8-174

ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.

IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.

(19D423469, Rev. 1)

VOLTAGE READINGS

VOLTAGE READINGS ARE TYPICAL READINGS MEASURED TO SYSTEM NEGATIVE (P903-10) WITH TEST SET MODEL 4EX3A11 OR A 20,000 OHM-PER-VOLT METER.

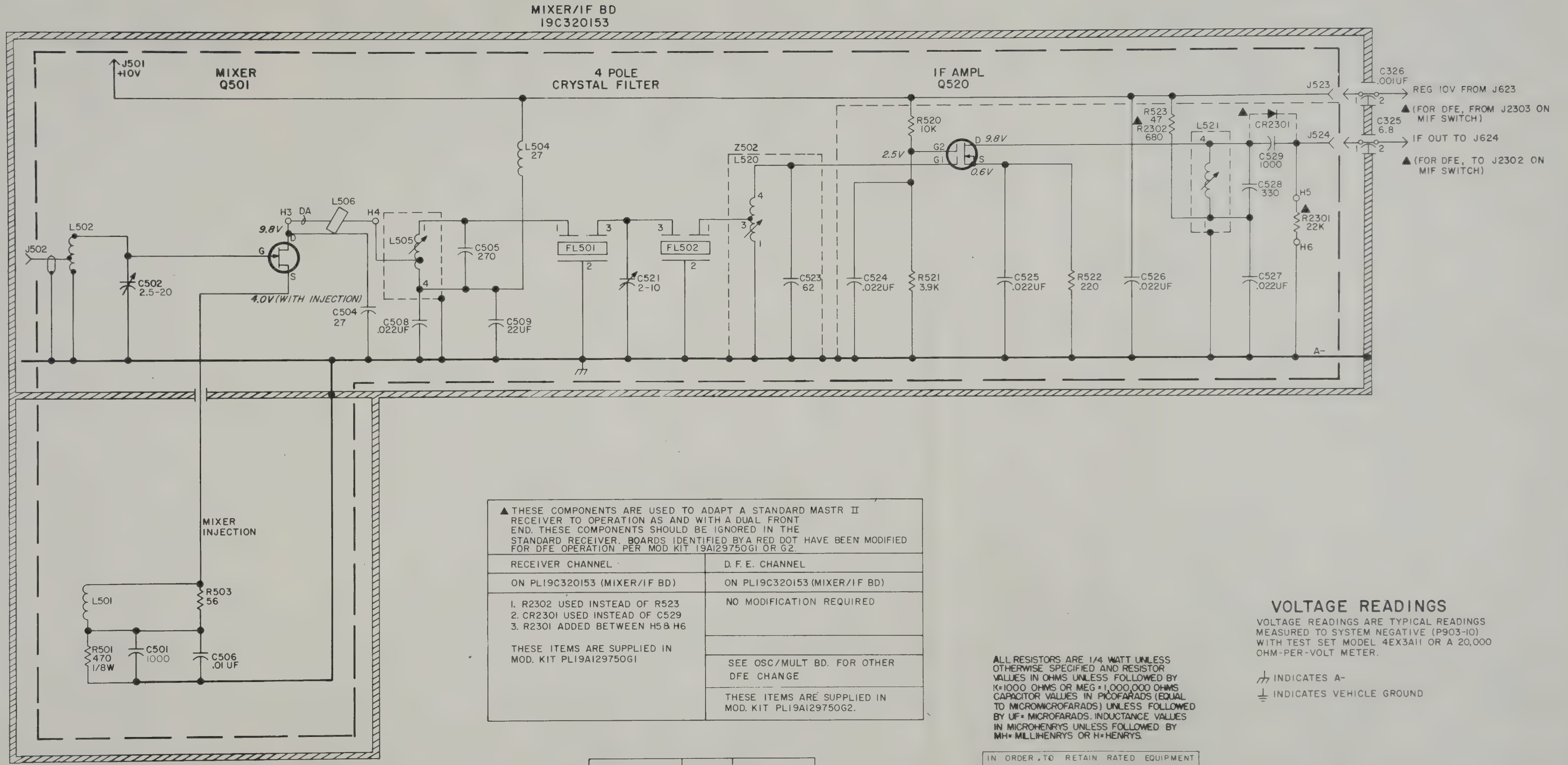
⫡ INDICATES A-

⏚ INDICATES VEHICLE GROUND

SCHEMATIC DIAGRAM

138—174 MHz RF ASSEMBLY

Issue 2


MIXER/IF BD
19C320153
J501
+10V
MIXER
Q501
4 POLE
CRYSTAL FILTER
IF AMPL
Q520
J502
L502
C502
2.5-20
G
D
S
9.8V
4.0V (WITH INJECTION)
H3
DA
L506
H4
L505
1
4
C504
27
C508
.022UF
C505
270
C509
22UF
L504
27
FL501
FL502
1
3
3
1
2
2
C521
2-10
Z502
L520
4
3
1
C523
62
R520
10K
2.5V
G2
G1
D 9.8V
S
0.6V
C524
.022UF
R521
3.9K
C525
.022UF
R522
220
R523
47
▲R2302
680
C526
.022UF
L521
4
▲
CR2301
C529
1000
C528
330
H5
▲R2301
22K
H6
C527
.022UF
A-
J523
J524
C326
.001UF
C325
6.8
1
2
1
2
REG 10V FROM J623
▲(FOR DFE, FROM J2303 ON MIF SWITCH)
IF OUT TO J624
▲(FOR DFE, TO J2302 ON MIF SWITCH)
MIXER
INJECTION
L501
R503
56
R501
470
1/8W
C501
1000
C506
.01 UF

▲ THESE COMPONENTS ARE USED TO ADAPT A STANDARD MASTR II RECEIVER TO OPERATION AS AND WITH A DUAL FRONT END. THESE COMPONENTS SHOULD BE IGNORED IN THE STANDARD RECEIVER. BOARDS IDENTIFIED BY A RED DOT HAVE BEEN MODIFIED FOR DFE OPERATION PER MOD KIT 19A129750G1 OR G2.	
RECEIVER CHANNEL	D. F. E. CHANNEL
ON PL19C320153 (MIXER/IF BD)	ON PL19C320153 (MIXER/IF BD)
1. R2302 USED INSTEAD OF R523 2. CR2301 USED INSTEAD OF C529 3. R2301 ADDED BETWEEN H5 & H6 THESE ITEMS ARE SUPPLIED IN MOD. KIT PL19A129750G1	NO MODIFICATION REQUIRED
	SEE OSC/MULT BD. FOR OTHER DFE CHANGE
	THESE ITEMS ARE SUPPLIED IN MOD. KIT PL19A129750G2.

	REV LETTER	FREQ RANGE (MHZ)
MIXER/IF BD		
19C320153G1	C	138-174

ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF=MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH=MILLIHENRYS OR H=HENRYS.

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VOLTAGE READINGS

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⏚ INDICATES A-

⏚ INDICATES VEHICLE GROUND

(19D423478, Rev. 2)

SCHEMATIC DIAGRAM

138—174 MHz MIXER/IF BOARD

OL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - - INDUCTORS - - - - - - - - - -
	19C320141P25	Coil.
	5493185P9	Tuning slug.
		COIL ASSEMBLY 19C320141G21
		- - - - - - - - - - - CAPACITORS - - - - - - - -
	5496218P305	Ceramic disc: 5.0 pf ±0.5 pf, 500 VDCW, temp coef -150 PPM.
		- - - - - - - - - - - INDUCTORS - - - - - - - - -
	19C320141P25	Coil.
	5493185P9	Tuning slug.
	19A127108G1	Coil.
		- - - - - - - - - - - - CABLES - - - - - - - - -
	5491689P85	Cable, RF: approx 4 inches long. (Includes P2302).
		- - - - - - - - - - MISCELLANEOUS - - - - - - - -
	19B219470P2	Shield.
	19A129424G1	Can. (Used with L505, L521, Z502 and T2301 on PRE-AMPLIFIER Board).
	4031594P1	Insulator. (Located under C502, C521).
	4035306P23	Washer, fiber. (Located under J502).
		RECEIVER MODIFICATION KIT 19A129750G1
		- - - - - - - - - - CAPACITORS - - - - - - - - -
	19A116656P8J0	Ceramic disc: 8 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
		- - - - - - - DIODES AND RECTIFIERS - - - - - -
	19A116925P1	Silicon, pin: 35 volt Reverse Breakdown, 400 mW.
		- - - - - - - - - - - RESISTORS - - - - - - - - - -
	3R152P223J	Composition: 22K ohms ±5%, 1/4 w.
	3R152P681K	Composition: 680 ohms ±10%, 1/4 w.
		- - - - - - - - - - - - CABLES - - - - - - - - - -
	19B219999G2	Cable: approx 1 foot long.
		DFE MODIFICATION KIT 19A129750G2
		- - - - - - - - - - CAPACITORS - - - - - - - - -
	19A116656P8J0	Ceramic disc: 8 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
	3R152P911J	Composition: 910 ohms ±5%, 1/4 w.

PRODUCTION CHANGES

Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter", which is stamped after the model number of the unit. The revision stamped on the unit includes all previous revisions. Refer to the Parts List for descriptions of parts affected by these revisions.

REV. A thru C - Mixer/IF Board 19C320153G1

REV. A and B - RF Assembly 19D416693G1,2

REV. A and B - Preamplifier Assembly 19C320215G1,2

Incorporated in initial shipment.

REV. C - RF Assembly 19D416693G2
To improve band end tuning. Changed C306 and C307.

LBI30057F
(DF1106)
(DF1118)
(IMTS)

MAINTENANCE MANUAL

138—174 MHz OSCILLATOR-MULTIPLIER BOARD 19C321740G1, G2

TABLE OF CONTENTS

Page
DESCRIPTION 1
CIRCUIT ANALYSIS 1
OUTLINE DIAGRAM 2
SCHEMATIC DIAGRAM 3
PARTS LIST AND PRODUCTION CHANGES 4

DESCRIPTION

The oscillator-multiplier board (osc-mult) for MASTR®Executive II contains a Colpitts oscillator, two multiplier stages and an amplifier. The operating frequency of the Colpitts oscillator is maintained within ±5 PPM by an externally compensated crystal module. The crystal frequencies range from approximately 14 to 18 megahertz and are multiplied nine times and then amplified to provide a low side injection frequency to the mixer. An optional modification kit is available for high side injection.

Oscillator-multiplier board 19C321740G1 is used in radios with receive frequencies between 138 MHz and 155 MHz. Oscillator-multiplier board 19C321740G2 is used in radios with receive frequencies between 150.8 MHz and 174 MHz.

CIRCUIT ANALYSIS

F1 OSCILLATOR CIRCUIT

Transistor Q402, a plug-in crystal module, trimmer capacitor, varicap and associated components comprise a Colpitts oscillator operating at the assigned F1 receive frequency.

The crystal module, located in the base circuit of Q402, is temperature compensated to maintain frequency stability over a temperature range of -30°C to +60°C. Compensation voltage from the exciter is applied through P602-1 to pin four of the crystal modules.

The compensation voltage varies nonlinearly with temperature to complement the temperature/frequency characteristics of the crystal. Listed below are typical minimum and maximum voltage readings to be expected at pin 4 of the crystal modules, as measured with a high impedance meter.

TEMPERATURE RANGE	OUTPUT VOLTAGE MINIMUM	OUTPUT VOLTAGE MAXIMUM
-30°C	4.9 Volts	6.0 Volts
-10°C to +50°C	3.7 Volts	4.3 Volts
+75°C	3.3 Volts	3.8 Volts

Trimmer capacitor C3 is used to adjust the radio for the exact operating frequency. Refer to the Alignment Procedure for details.

Refer to the System Maintenance Manual for circuit details of the crystal modules.

SERVICE NOTE

Y1 and C2 are not field replaceable items. C2 is factory selected to compliment the temperature/frequency characteristics of each individual crystal. Should it become necessary to replace either Y1 or C2, the entire crystal module must be replaced.

In single frequency applications, the F1 keying lead is wired to A- by a DA jumper wire connected between H12-H31 on the SAS board. A voltage divider network consisting of R407 and R408 sets the bias for oscillator transistor Q402.

In multi-frequency radios this jumper (H12-H31) is removed to allow F1 frequency selection via the frequency selector switch on the control unit.

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WORLD HEADQUARTERS • LYNCHBURG, VIRGINIA 24502 U.S.A.

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PARTS LIST

LBI4981C

138-174 MHz RF ASSEMBLY,
MIF ASSEMBLY,
UHS PRE-AMPLIFIER

SYMBOL	GE PART NO.	DESCRIPTION
		RF ASSEMBLY 19D416693G1 138-155 MHz FLOATING GRD 19D416693G2 150.8-174 MHz FLOATING GRD 19D416693G7 138-155 MHz NON FLOATING GRD 19D416693G8 150.8-174 MHz NON FLOATING GRD
A301A		ANTENNA INPUT BOARD 19B219680G1
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	19A116679P470K	Mica: 470 pf ±10%, 250 VDCW.
C2	19A116080P101	Polyester: 0.01 µf ±10%, 50 VDCW.
		- - - - - - - - JACKS AND RECEPTACLES - - - - - - - -
J1	7104941P16	Connector, phono: Jack; sim to National Tel.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	3R152P472J	Composition: 4.7K ohms ±5%, 1/4 w.
A301B		ANTENNA INPUT PLATE 19A137683G1
		- - - - - - - - - - JACKS AND RECEPTACLES - - - - - - -
J1	7104941P16	Connector, phono: Jack; sim to National Tel. Barrel Ceramic.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	3R152P472J	Composition: 4.7K ohms ±5%, 1/4 w.
A302 and A303		COMPONENT BOARD A302 19B226512G1 138-155 MHz A303 19B226512G2 150.8-174 MHz
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L305	19B216112G20	Coil.
L315	19B216112G21	Coil.
		- - - - - - - - - - CABLES - - - - - - - - - -
P301	5491689P85	Cable, RF: approx 4 inches long, 350 VRMS, 500 VDC operating voltage.
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C301 thru C305		Includes:
	4036765G11	Screw.
	7137968P8	Nut, stamped: thd size No. 6-32; sim to Palnut TO632005.
C306* and C307*		Includes:
	4036765G11	Screw. (Added to G2 by REV C).
	4036765G12	Screw. (Deleted in G2 by REV C).
	7137968P8	Nut, stamped: thd size No. 6-32; sim to Palnut TO632005.
C308	5494481P11	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C325	19B209488P1	Ceramic, feed-thru: 6.8 pf ±20%, 500 VDCW; sim to Allen-Bradley Style FA5D.
C326	19B209488P2	Ceramic, feed-thru: 1000 pf +100% -0%, 500 VDCW; sim to Allen-Bradley Style FA5H.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L301	19B216112G19	Coil.
L302 thru L304	19B216112G11	Coil.
L306 and L307	19B204461G18	Coil.
L311	19B216112G17	Coil.
L312 thru L314	19B216112G15	Coil.
L316 and L317	19B204461G19	Coil.
		- - - - - - - - - - MISCELLANEOUS - - - - - - -
	19E500969G1	Casting.
	19C320251P1	Cover.
	19B209209P305	Tap screw, Phillips POZIDRIV®: No. 6-32 x 5/16. (Secures cover).
	19B201074P304	Tap screw, Phillips POZIDRIV®: No. 6-32 x 1/4. (Used with A301-A303).
		MIF ASSEMBLY 19C320153G1
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C501	19A116655P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C502	19B209351P2	Variable, ceramic: 2.5 to 20 pf, 200 VDCW, temp coef -250 +700 PPM/°C; sim to Matshushita ECV-1Z-W20P32.
C504	19A116656P27K0	Ceramic disc: 27 pf ±10%, 500 VDCW, temp coef 0 PPM.
C505	7489162P37	Silver mica: 270 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C506	19A116080P101	Polyester: 0.01 µf ±10%, 50 VDCW.
C508	19A116080P103	Polyester: 0.022 µf ±10%, 50 VDCW.
C509	5496267P10	Tantalum: 22 µf ±20%, 15 VDCW; sim to Sprague Type 150D.
C521	19B209351P1	Variable: 2 to 10 pf, 200 VDCW, temp coef -350 to +500 PPM/°C; sim to Matshushita ECV-1ZW10P32.
C523		(Part of Z502).
C524 thru C527	19A116080P3	Polyester: 0.022 µf ±20%, 50 VDCW.
C528	5490008P139	Silver mica: 330 pf ±10%, 500 VDCW; sim to Electro Motive Type DM-15.
C529	19A116655P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
		- - - - - - - - - - TERMINALS - - - - - - - - - -
E10 and E11	19B209055P8	Terminal, feed-thru: sim to Electrical Ind. ABAS40WSS.
		- - - - - - - - - - - FILTERS - - - - - - - - - -
FL501	19B219573G7	Crystal, freq: Resonator A: 11,200000 KHz, Resonator B: 11,196024 KHz, Resonator A: 11,200000 KHz, Resonator B: 11,196024 KHz.
FL502		(Part of FL501).
		- - - - - - - - JACKS AND RECEPTACLES - - - - -
J501	4033513P1	Contact, electrical: sim to Bead Chain L93-4.
J502	19A130924G1	Receptacle, coaxial: sim to Cinch 14H11613.
J523 and J524	19A116975P1	Receptacle, wire spring.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L501	19A129280P1	Coil.
L502		Coil. (Part of printed wire board 19C321054P1).
L504	7488079P48	Choke, RF: 27.0 µh ±10%, 1.40 ohms DC res max; sim to Jeffers 4422-9K.
L505	19C320141G30	Coil. Includes:
	5493185P9	Tuning slug.
L506	19A126140P1	Core, toroidal.
L520		(Part of Z502).
L521	19C320141G6	Coil. Includes:
	5493185P9	Tuning slug.
		- - - - - - - - - - TRANSISTORS - - - - - - - -
Q501	19A134093P1	N Type, field effect; sim to Type 2N4391.
Q520	19A116818P1	N Channel, field effect; sim to Type 3N187.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R501	3R151P471J	Composition: 470 ohms ±5%, 1/8 w.
R503	3R152P560K	Composition: 56 ohms ±10%, 1/4 w.
R520	3R152P103K	Composition: 10K ohms ±10%, 1/4 w.
R521	3R152P392J	Composition: 3.9K ohms ±5%, 1/4 w.
R522	3R152P221J	Composition: 220 ohms ±5%, 1/4 w.
R523	3R152P470J	Composition: 47 ohms ±5%, 1/4 w.
		- - - - - - - - - - NETWORKS - - - - - - - - - -
Z502		COIL ASSEMBLY 19C320141G20
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C523	19A116114P1057	Ceramic: 62 pf ±5%, 100 VDCW; temp coef -30 PPM.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L520	19C320141P4	Coil.
	5493185P9	Tuning slug.
		UHS PRE-AMPLIFIER BOARD 19C320215G1 138-158 MHz 19C320215G2 147-174 MHz
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C2301	19A116795P250K	Mica: 250 pf ±10%, 250 VDCW; sim to Underwood Type J1HF.
C2302L		(Part of T2301L).
C2302H		(Part of T2301H).
C2303 thru C2306	19A116655P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
		- - - - - - - - JACKS AND RECEPTACLES - - - - - - - -
J2301	19A130924G1	Connector, receptacle: coaxial, jack type; sim to Cinch 14H11613.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P2301	4029840P2	Contact, electrical: sim to Amp 42827-2.
P2302		(Part of W2302).
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q2301	19A116818P1	N Channel, field effect; sim to Type 3N187.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R2301	3R152P101K	Composition: 100 ohms ±10%, 1/4 w.
R2303	3R152P103K	Composition: 10K ohms ±10%, 1/4 w.
R2304	3R152P752J	Composition: 7.5K ohms ±5%, 1/4 w.
R2305	3R152P300J	Composition: 30 ohms ±5%, 1/4 w.
		- - - - - - - - - - TRANSFORMERS - - - - - - - - - -
T2301L		COIL ASSEMBLY 19C320141G22
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C4	5496218P308	Ceramic disc: 8.0 pf ±0.5 pf, 500 VDCW, temp coef -150 PPM.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L1	19C320141P25	Coil.
	5493185P9	Tuning slug.
T2301H		COIL ASSEMBLY 19C320141G21
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C5	5496218P305	Ceramic disc: 5.0 pf ±0.5 pf, 500 VDCW, temp coef -150 PPM.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L1	19C320141P25	Coil.
	5493185P9	Tuning slug.
T2302	19A127108G1	Coil.
		- - - - - - - - - - CABLES - - - - - - - - - -
W2302	5491689P85	Cable, RF: approx 4 inches long. (Includes P2302).
		- - - - - - - - - - MISCELLANEOUS - - - - - - - - - -
	19B219470P2	Shield.
	19A129424G1	Can. (Used with L505, L521, Z502 and T2301 on PRE-AMPLIFIER Board).
	4031594P1	Insulator. (Located under C502, C521).
	4035306P23	Washer, fiber. (Located under J502).
		RECEIVER MODIFICATION KIT 19A129750G1
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C2301	19A116656P8J0	Ceramic disc: 8 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
		- - - - - - - - DIODES AND RECTIFIERS - - - - - -
CR2301	19A116925P1	Silicon, pin: 35 volt Reverse Breakdown, 400 mW.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R2301	3R152P223J	Composition: 22K ohms ±5%, 1/4 w.
R2302	3R152P681K	Composition: 680 ohms ±10%, 1/4 w.
		- - - - - - - - - - CABLES - - - - - - - - - -
W2301	19B219999G2	Cable: approx 1 foot long.
		DFE MODIFICATION KIT 19A129750G2
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C2301	19A116656P8J0	Ceramic disc: 8 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R2303	3R152P911J	Composition: 910 ohms ±5%, 1/4 w.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

PRODUCTION CHANGES

Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter", which is stamped after the model number of the unit. The revision stamped on the unit includes all previous revisions. Refer to the Parts List for descriptions of parts affected by these revisions.

REV. A thru C - Mixer/IF Board 19C320153G1

REV. A and B - RF Assembly 19D416693G1,2

REV. A and B - Preamplifier Assembly 19C320215G1,2

Incorporated in initial shipment.

REV. C - RF Assembly 19D416693G2

To improve band end tuning. Changed C306 and C307.

GE MOBILE RADIO

LBI30057F
(DF1106)
(DF1118)
(IMTS)

MAINTENANCE MANUAL
138—174 MHz OSCILLATOR-MULTIPLIER BOARD 19C321740G1, G2

TABLE OF CONTENTS

Page
DESCRIPTION 1
CIRCUIT ANALYSIS 1
OUTLINE DIAGRAM 2
SCHEMATIC DIAGRAM 3
PARTS LIST AND PRODUCTION CHANGES 4

DESCRIPTION

The oscillator-multiplier board (osc-mult) for MASTR®Executive II contains a Colpitts oscillator, two multiplier stages and an amplifier. The operating frequency of the Colpitts oscillator is maintained within ±5 PPM by an externally compensated crystal module. The crystal frequencies range from approximately 14 to 18 megahertz and are multiplied nine times and then amplified to provide a low side injection frequency to the mixer. An optional modification kit is available for high side injection.

Oscillator-multiplier board 19C321740G1 is used in radios with receive frequencies between 138 MHz and 155 MHz. Oscillator-multiplier board 19C321740G2 is used in radios with receive frequencies between 150.8 MHz and 174 MHz.

CIRCUIT ANALYSIS

F1 OSCILLATOR CIRCUIT

Transistor Q402, a plug-in crystal module, trimmer capacitor, varicap and associated components comprise a Colpitts oscillator operating at the assigned F1 receive frequency.

The crystal module, located in the base circuit of Q402, is temperature compensated to maintain frequency stability over a temperature range of -30°C to +60°C. Compensation voltage from the exciter is applied through P602-1 to pin four of the crystal modules.

The compensation voltage varies non-linearly with temperature to complement the temperature/frequency characteristics of the crystal. Listed below are typical minimum and maximum voltage readings to be expected at pin 4 of the crystal modules, as measured with a high impedance meter.

TEMPERATURE RANGE	OUTPUT VOLTAGE MINIMUM	MAXIMUM
-30°C	4.9 Volts	6.0 Volts
-10°C to +50°C	3.7 Volts	4.3 Volts
+75°C	3.3 Volts	3.8 Volts

Trimmer capacitor C3 is used to adjust the radio for the exact operating frequency. Refer to the Alignment Procedure for details.

Refer to the System Maintenance Manual for circuit details of the crystal modules.

SERVICE NOTE

Y1 and C2 are not field replaceable items. C2 is factory selected to compliment the temperature/frequency characteristics of each individual crystal. Should it become necessary to replace either Y1 or C2, the entire crystal module must be replaced.

In single frequency applications, the F1 keying lead is wired to A- by a DA jumper wire connected between H12-H31 on the SAS board. A voltage divider network consisting of R407 and R408 sets the bias for oscillator transistor Q402.

In multi-frequency radios this jumper (H12-H31) is removed to allow F1 frequency selection via the frequency selector switch on the control unit.

GENERAL ELECTRIC COMPANY • MOBILE COMMUNICATIONS DIVISION
WORLD HEADQUARTERS • LYNCHBURG, VIRGINIA 24502 U.S.A.

GENERAL ELECTRIC*
U.S.A.

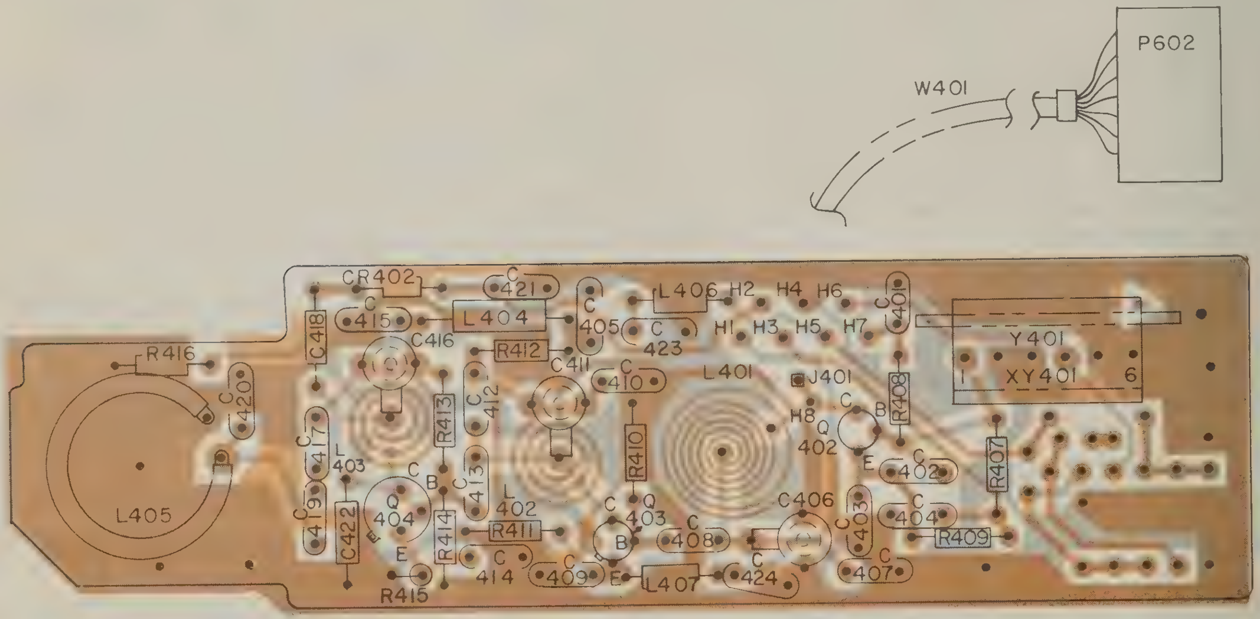
* Trademark of General Electric Company U.S.A.
Printed in U.S.A.

With the radio turned on and the PTT switch released, +10V is present on the Rx OSC control lead at P602-6 and the oscillator operates at the crystal frequency. Capacitor C402 provides the necessary inphase feedback to sustain oscillations.

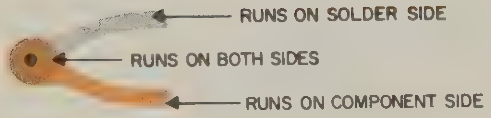
C406 is tuned to three times the crystal frequency. The output of the tuned circuit is applied to the base of Class C multiplier, Q403. The collector tank cicuit of the multiplier (L402, C411, and C412) is tuned to nine times the crystal frequency. The output of the multiplier stage is metered across R411 and applied to receiver metering jack J601 through P602-3.

Following the multiplier is a Class A Amplifier stage, Q404. The output of Q404 is metered through a metering network consisting of C418, C421, CR402, and R416 and applied to receiver metering jack J601 through P602-4. The amplifier output of Q404 is applied to a tuned circuit (L403 and C416) that is tuned to nine times the crystal frequency. The tuned circuit provides additional selectivity in the oscillator-multiplier chain.

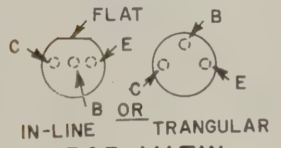
The output of the oscillator/multiplier board is inductively coupled through L405 and two helical resonators on the RF assembly to the input of the mixer stage.


P602
W401
CR402
C421
L406
H2
H4
H6
C401
C415
L404
C405
C423
H1
H3
H5
H7
C418
C416
R412
Y401
R416
C411
C410
L401
J401
XY401
1
6
C420
R413
C412
H8
Q402
C
B
E
R408
C417
L403
C402
R410
R407
C413
L402
C406
C419
Q404
Q403
C404
C422
R414
R411
C408
C403
R409
C414
C409
L407
C424
C407
E
R415
L405

(19D423413, Sh. 2, Rev. 4)
(19D423413, Sh. 3, Rev. 4)


RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE

LEAD IDENTIFICATION
FOR Q402, Q404


FLAT
C
E
B
B
C
E
IN-LINE
OR
TRANGULAR

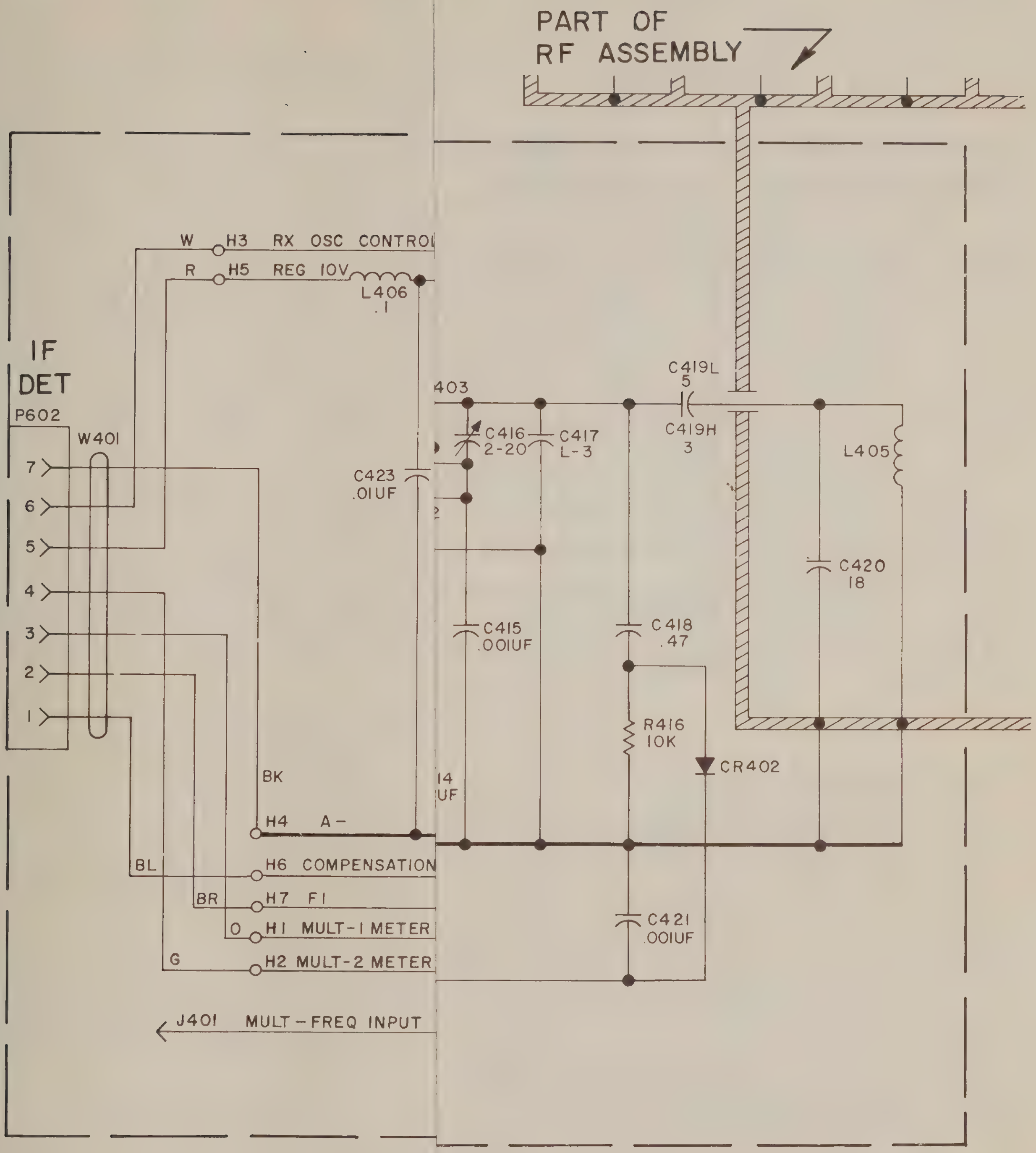
TOP VIEW

NOTE: LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION. TAB INDICATES EMITTER LEAD.

(19C327116, Rev. 5)

OUTLINE DIAGRAM

138—174 MHz OSCILLATOR-MULTIPLIER


PART OF
RF ASSEMBLY
IF
DET
P602
W401
7
6
5
4
3
2
1
W
H3 RX OSC CONTROL
R
H5 REG 10V
L406
.1
403
C416
2-20
C417
L-3
C419L
5
C419H
3
L405
C423
.01UF
C420
18
C415
.001UF
C418
.47
R416
10K
CR402
14
UF
BK
H4 A-
BL
H6 COMPENSATION
BR
H7 FI
O
H1 MULT-1 METER
G
H2 MULT-2 METER
C421
.001UF
J401 MULT-FREQ INPUT

ADINGS

E TYPICAL READINGS
M NEGATIVE (P903-10)
L 4EX3A11 OR A 20,000
R.

SCHEMATIC DIAGRAM

138—174 MHz OSCILLATOR-MULTIPLIER

Issue 6

With the radio turned on and the PTT switch released, +10V is present on the Rx OSC control lead at P602-6 and the oscillator operates at the crystal frequency. Capacitor C402 provides the necessary inphase feedback to sustain oscillations.

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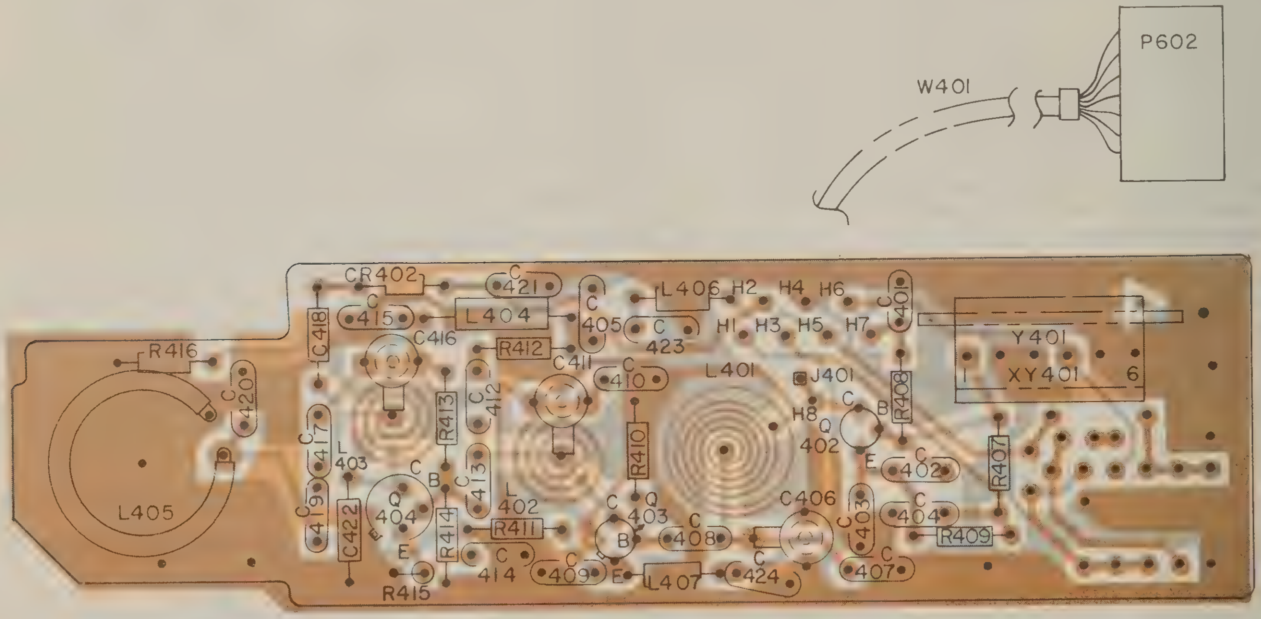
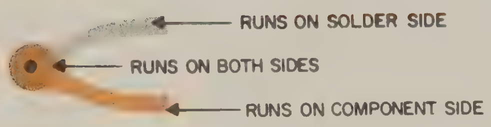
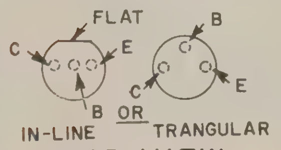

P602
W401
CR402
C421
C415
L404
C418
C405
L406
H2
H4
H6
C401
H1
H3
H5
H7
C423
Y401
XY401
1
6
R416
C416
R412
C411
C410
L401
J401
C420
C417
L403
R413
C412
H8
Q402
C
B
E
R410
R408
C402
R407
Q404
B
E
C413
L402
Q403
C406
C403
C404
C419
C422
R414
R411
C408
R409
L405
R415
C414
C409
L407
C424
C407

(19D423413, Sh. 2, Rev. 4)
(19D423413, Sh. 3, Rev. 4)


RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE

LEAD IDENTIFICATION
FOR Q402, Q404


FLAT
C
E
B
IN-LINE
OR
B
C
E
TRANGULAR

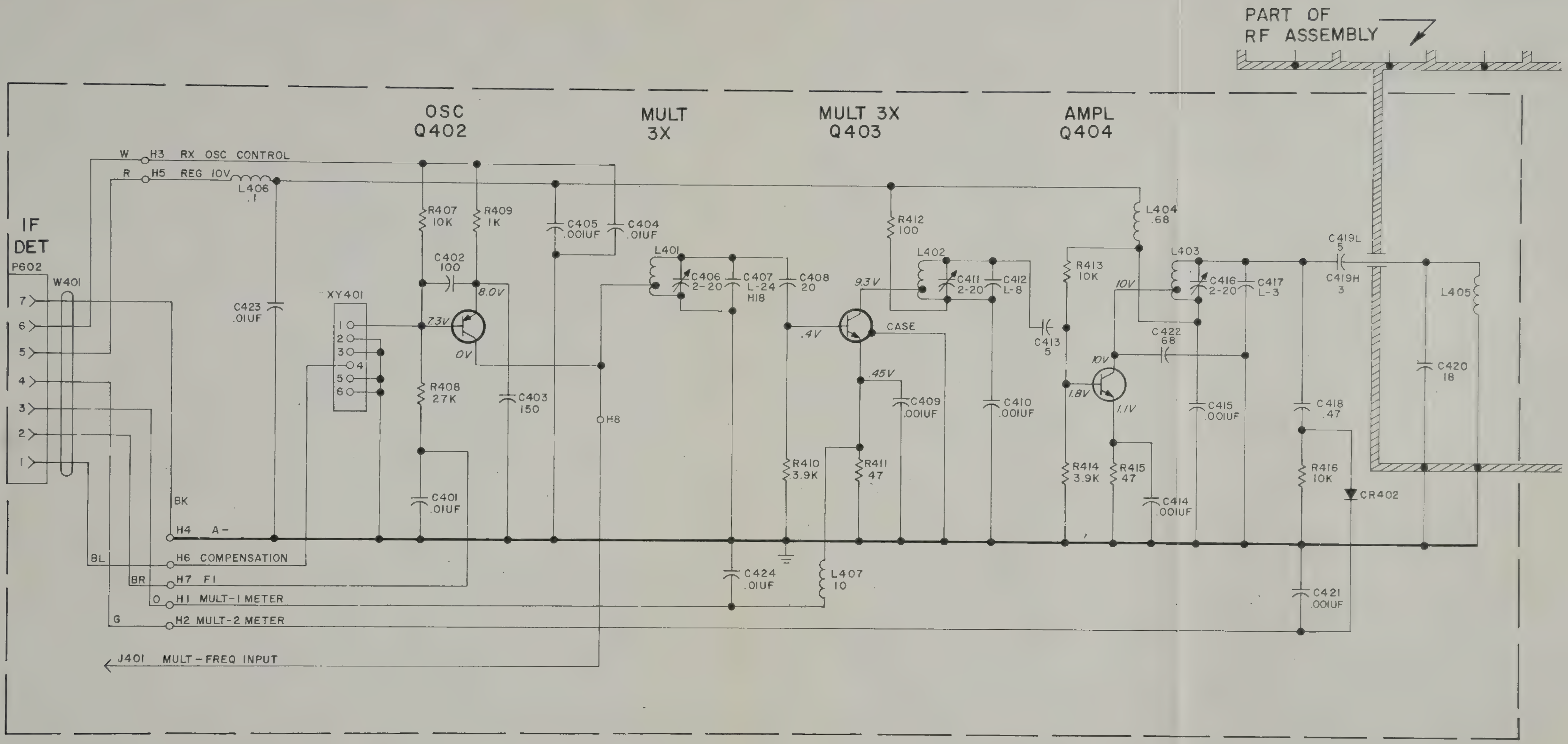
TOP VIEW

NOTE: LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION. TAB INDICATES EMITTER LEAD.

(19C327116, Rev. 5)

OUTLINE DIAGRAM

138—174 MHz OSCILLATOR-MULTIPLIER


PART OF
RF ASSEMBLY
OSC
Q402
MULT
3X
MULT 3X
Q403
AMPL
Q404
IF
DET
P602
W401
7
6
5
4
3
2
1
W
H3
RX OSC CONTROL
R
H5
REG 10V
L406
.1
C423
.01UF
XY401
1
2
3
4
5
6
R407
10K
R409
1K
C402
100
8.0V
7.3V
0V
R408
27K
C403
150
C401
.01UF
C405
.001UF
C404
.01UF
H8
L401
C406
2-20
C407
L-24
H18
C408
20
C424
.01UF
L407
10
R412
100
L402
9.3V
.4V
CASE
C411
2-20
C412
L-8
.45V
C409
.001UF
C410
.001UF
R410
3.9K
R411
47
L404
.68
R413
10K
10V
L403
C416
2-20
C417
L-3
C413
5
C422
.68
10V
1.8V
1.1V
C415
.001UF
R414
3.9K
R415
47
C414
.001UF
C419L
5
C419H
3
L405
C420
18
C418
.47
R416
10K
CR402
C421
.001UF
BK
H4 A-
BL
H6 COMPENSATION
BR
H7 FI
O
H1 MULT-1 METER
G
H2 MULT-2 METER
J401 MULT-FREQ INPUT

ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.

IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.

OSC / MULT	REV LETTER	FREQ RANGE (MHz)
19C321740G1	D	138-155
19C321740G2	E	150.8-174

VOLTAGE READINGS

VOLTAGE READING ARE TYPICAL READINGS MEASURED TO SYSTEM NEGATIVE (P903-10) WITH TEST SET MODEL 4EX3A11 OR A 20,000 OHM-PER-VOLT METER.

SCHEMATIC DIAGRAM

138—174 MHz OSCILLATOR-MULTIPLIER

(19D423491, Rev. 9)

SYMBOL	GE PART NO.	DESCRIPTION
C2313	19A116656P5J0	Ceramic disc: 5 pf ±1 pf, 500 VDCW, temp coef 0 PPM.
C2314	19A116656P4J0	Ceramic disc: 4 pf ±1 pf, 500 VDCW, temp coef 0 PPM.
C2318	19A116656P10J8	Ceramic disc: 10 pf ±1 pf, 500 VDCW, temp coef -80 PPM.
		- - - - - - - - - MISCELLANEOUS - - - - - - - -
	19A130028P1	Spacer.
	19A130028P2	Spacer.
	19A130029P1	Washer, brass.
		- - - - - - - - - CRYSTAL MODULE - - - - - - - -
		NOTE: When reordering, give GE Part Number and specify exact operating frequency needed.
		For Standard Low Side Injection Frequency.
Y401	19B226962G13	Rx. 5 PPM. (138-155 MHz).
	19B226962G14	Rx. 5 PPM. (150.8-174 MHz).
		NOTE: For High Side Injection Frequency Using High Side Modification Kit 19A130045G1.
	19B226962G19	Rx. 5 PPM. (138-155 MHz).
	19B226962G20	Rx. 5 PPM. (150.8-174 MHz).

PRODUCTION CHANGES

Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter," which is stamped after the model number of the unit. The revision stamped on the unit includes all previous revisions. Refer to the Parts List for descriptions of parts affected by these revisions.

REV. A - Oscillator/Multiplier Board 19C321740G1, G2

To prevent suprious 600 MHz oscillation of amplifier Q404. Added C422.

REV. B - To improve operation. Added C422, C423, C424, L406 and L407.

REV. C - Oscillator/Multiplier Board 19C321740G2

Improve tuning at high end of frequency board. Deleted C412H. Add C419H.

REV. C - Oscillator/Multiplier Board 19C321740G1

To improve operation. Changed Q403.

REV. D - Oscillator/Multiplier Board 19C321740G2

To improve operation. Changed Q403.

REV. D - Oscillator/Multiplier Board 19C321740G1
REV. E - Oscillator/Multiplier Board 19C321740G2

To incorporate new transistor. Changed Q404.

LBI30049E
(DF1105)
(DF1118, IMTS)

MAINTENANCE MANUAL

IF-DETECTOR BOARD 19C321662G1-G3, G7-G9

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DESCRIPTION 1
CIRCUIT ANALYSIS 1
OUTLINE DIAGRAM 2
SCHEMATIC DIAGRAM 3
PARTS LIST 4

DESCRIPTION

The IF-Detector board (IF-DET) provides approximately 120 dB gain at the IF frequency, detects the audio frequencies and provides the volume squelch Hi output to the System-Audio & Squelch board (SAS). The F1 keying lead, and RX OSC control from the SAS board, compensation voltage from the exciter and the requlated +10 Volt circuits are completed through P903 and J602 on the IF-DET board.

IF-DET board 19C321662G2, G8 contains a 4-pole and a 2-pole crystal filter and operates with an IF frequency of 9.4 MHz. It is used in radios with an operating frequency of 29.7-36 MHz, 42-50 MHz and 851-870 MHz.

IF-DET board 19C321662G1, G7 also contains a 4-pole and a 2-pole crystal filter it operates with an IF frequency of 11.2 MHz and is used in radios with an operating frequency between 36-42 MHz and 66-88 MHz.

IF-DET board 19C321662G3, G9 contains two 2-pole crystal filters and operates with an IF frequency of 11.2 MHz. It is used in radios with an operating frequency of 138-174 MHz, and 406-512 MHz.

CIRCUIT ANALYSIS

CRYSTAL FILTERS, IF AMP & LIMITER-DETECTOR

The IF input from the MIF or IF Filter board is applied to a monolithic crystal filter (FL601 and FL602). The crystal filter provides additional selectivity and is followed by an impedance matching network Z601 and IF amplifier U601. The IC amplifier provides approximately 60 dB gain.

Final IF selectivity is provided by two-pole crystal filter FL603. Impedance matching network Z602 matches the output impedance of IF amplifier IC U601 to the input of two-pole crystal filter FL603. The IF amplifier output is metered at J601-1 through a metering network consisting of C612, C613, CR601 and CR602. Impedance matching network Z603 matches the output impedance of FL603 to the input of Limiter-Detector IC U602.

In addition to providing 60 dB of gain at the IF frequency, Limiter-Detector IC U602, C620, C621 and L603 comprise a quadrature phase detector to recover the audio from the IF frequency. The quadrature phase detector utilizes a 90 degree phase shift in the IF frequency to detect the audio signal. It compares the phase of the IF input at U602-4 with the same IF input frequency shifted 90 degrees at U602-2. The resultant signal varies phase linearly as the carrier signal deviates about the center frequency.

The detector output is adjusted for maximum audio output by L603 and is metered at J601-2 through R607.

AUDIO PREAMPLIFIER

The audio preamplifier consists of transistors Q601, Q602, and Q603. It provides approximately 26 dB of gain.

The output of the Limiter-Detector is coupled to the audio preamplifier through audio level adjust control R608. R608 sets the audio input level to the preamplifier circuit.

The output of the audio preamplifier is coupled through a low pass filter (L604 and C626) to volume and squelch control circuit on the SAS board. The filter removes any IF signal remaining in the audio output of the preamplifier.

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PARTS LIST

LBI30082F

OSCILLATOR - MULTIPLIER BOARD
19C321740G1 138-155 MHz
19C321740G2 150.8-174 MHz

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - - CAPACITORS - - - - - - - - -
C401	19A116080P101	Polyester: 0.01 µf ±10%, 50 VDCW.
C402	5496218P763	Ceramic disc: 100 pf ±5%, 500 VDCW, temp coef -750 PPM.
C403	19A700105P38	Mica: 150 pf ±5%, 500 VDCW.
C404	19A116080P101	Polyester: 0.01 µf ±10%, 50 VDCW.
C405	19A116655P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C406	19A700012P2	Variable, ceramic: 2.5-20 pf, 200 VDCW, temp coef -250 to -700 Parts/M/°C; sim to Panasonic ECV-1ZW20X32.
C407L	19A116656P24J8	Ceramic disc: 24 pf ±5%, 500 VDCW, temp coef -80 PPM.
C407H	19A116656P18J8	Ceramic disc: 18 pf ±5%, 500 VDCW, temp coef -80 PPM.
C408	19A6656P20K0	Ceramic disc: 20 pf ±10%, 500 VDCW, temp coef 0 PPM.
C409 and C410	19A116655P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C411	19A700012P2	Variable, ceramic: 2.5-20 pf, 200 VDCW, temp coef -250 to -700 Parts/M/°C sim to Panasonic ECV-1ZW20X32.
C412L	19A116656P8J0	Ceramic disc: 8 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C412H*	19A116656P5J0	Ceramic disc: 5 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM. Deleted by REV C.
C413	19A116656P5K0	Ceramic disc: 5 pf ±1 pf, 500 VDCW, temp coef 0 PPM.
C414 and C415	19A116655P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C416	19A700012P2	Variable, ceramic: 2.5-20 pf, 200 VDCW, temp coef -250 to -700 Parts/M/°C sim to Panasonic ECV-1ZW20X32.
C417L	19A116656P3J0	Ceramic disc: 3 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C418	5491601P13	Phenolic: 0.47 pf ±10%, 500 VDCW.
C419L	19A116656P5J0	Ceramic disc: 5 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C419H*	19A116656P3J0	Ceramic disc: 3 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
		In REV B & earlier:
	19A116656P5J0	Ceramic disc: 5 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C420	19A116656P18J0	Ceramic disc: 18 pf ±5%, 500 VDCW, temp coef 0 PPM.
C421	19A116655P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C422*	19A700013P11	Phenolic: 0.68 pf ±5%, 500 VDCW. Added by REV B.
C423* and C424*	19A116080P101	Polyester: 0.01 µf ±10%, 50 VDCW. Added by REV B
		- - - - - - - - - DIODES AND RECTIFIERS - - - - - -
CR402	19A116052P5	Silicon, hot carrier: Fwd. drop .500 v. max.
		- - - - - - - - - JACKS AND RECEPTACLES - - - - - -
J401	19A116779P1	Contact, electrical: sim to Molex 08-50-0404.
		- - - - - - - - - - - INDUCTORS - - - - - - - - -
L401 thru L403		(Part of Printed board 19D423413P1).
L404	19A700000P10	Coil, RF: 680 nH ±10%, 0.15 ohms DC res max.
L405	19A129280P1	Coil.
L406*	19B209420P101	Coil, RF: 0.10 µh ±10%, 0.08 ohms DC res max; sim to Jeffers 4416-1K. Added by REV B.
L407*	19A700024P25	Coil, RF: 10 µh ±10%, 3.70 ohms DC res max. Added by REV B.
		- - - - - - - - - - - - PLUGS - - - - - - - - - -
P602		(Part of W401).
		- - - - - - - - - - - TRANSISTORS - - - - - - - -
Q402	19A115852P1	Silicon, PNP; sim to Type 2N3906.
Q403*	19A134670P1	Silicon, NPN.
		In G1 of REV B & earlier: In G2 of REV C & earlier:
	19A115440P1	Silicon, NPN.
Q404*	19A116899P1	Silicon, NPN; sim to Type 2N2368.
		In G1 of REV C & earlier: In G2 of REV D & earlier:
	19A115329P2	Silicon, NPN.
		- - - - - - - - - - - RESISTORS - - - - - - - - -
R407	19A700106P87	Composition: 10K ohms ±5%, 1/4 w.
R408	19A700106P97	Composition: 27K ohms ±5%, 1/4 w.
R409	19A700106P63	Composition: 1K ohms ±5%, 1/4 w.
R410	19A700106P77	Composition: 3.9K ohms ±10%, 1/4 w.
R411	19A700106P31	Composition: 47 ohms ±5%, 1/4 w.
R412	19A700106P39	Composition: 100 ohms ±10%, 1/4 w.
R413	19A700106P87	Composition: 10K ohms ±10%, 1/4 w.
R414	19A700106P77	Composition: 3.9K ohms ±5%, 1/4 w.
R415	19A700106P31	Composition: 47 ohms ±5%, 1/4 w.
R416	19A700106P87	Composition: 10K ohms ±10%, 1/4 w.
		- - - - - - - - - - - - CABLES - - - - - - - - -
W401	19B226965G1	Cable, includes (P602) 19A116659P82.
		- - - - - - - - - - - SOCKETS - - - - - - - - - -
XY401	19A116659P50	Connector, printed wiring: 6 contacts; sim to Molex 09-65-1061.
		- - - - - - - - - - - MISCELLANEOUS - - - - - - - -
	4031594P1	Insulator. (Used with C406, C411, C416).
		- - - - - - - - - ASSOCIATED PARTS - - - - - - - -
		HIGH SIDE INJECTION MODIFICATION KIT 19A130045G2
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C2311	19A116656P12K0	Ceramic disc: 12 pf ±10%, 500 VDCW, temp coef 0 PPM.
C2312	19A116656P3J0	Ceramic disc: 3 pf ±1 pf, 500 VDCW, temp coef 0 PPM.
C2313	19A116656P5J0	Ceramic disc: 5 pf ±1 pf, 500 VDCW, temp coef 0 PPM.
C2314	19A116656P4J0	Ceramic disc: 4 pf ±1 pf, 500 VDCW, temp coef 0 PPM.
C2318	19A116656P10J8	Ceramic disc: 10 pf ±1 pf, 500 VDCW, temp coef -80 PPM.
		- - - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19A130028P1	Spacer.
	19A130028P2	Spacer.
	19A130029P1	Washer, brass.
		- - - - - - - - - - CRYSTAL MODULE - - - - - - - - -
		NOTE: When reordering, give GE Part Number and specify exact operating frequency needed.
		For Standard Low Side Injection Frequency.
Y401	19B226962G13	Rx. 5 PPM. (138-155 MHz).
	19B226962G14	Rx. 5 PPM. (150.8-174 MHz).
		NOTE: For High Side Injection Frequency Using High Side Modification Kit 19A130045G1.
	19B226962G19	Rx. 5 PPM. (138-155 MHz).
	19B226962G20	Rx. 5 PPM. (150.8-174 MHz).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

PRODUCTION CHANGES

Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter," which is stamped after the model number of the unit. The revision stamped on the unit includes all previous revisions. Refer to the Parts List for descriptions of parts affected by these revisions

REV. A - Oscillator/Multiplier Board 19C321740G1, G2
To prevent suprious 600 MHz oscillation of amplifier Q404. Added C422.

REV. B - To improve operation. Added C422, C423, C424, L406 and L407.

REV. C - Oscillator/Multiplier Board 19C321740G2
Improve tuning at high end of frequency board. Deleted C412H. Add C419H.

REV. C - Oscillator/Multiplier Board 19C321740G1
To improve operation. Changed Q403.

REV. D - Oscillator/Multiplier Board 19C321740G2
To improve operation. Changed Q403.

REV. D - Oscillator/Multiplier Board 19C321740G1
REV. E - Oscillator/Multiplier Board 19C321740G2
To incorporate new transistor. Changed Q404.

MOBILE RADIO

LBI30049E
(DF1105)
(DF1118, IMTS)

MAINTENANCE MANUAL

IF-DETECTOR BOARD 19C321662G1-G3, G7-G9

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OUTLINE DIAGRAM 2

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PARTS LIST 4

DESCRIPTION

The IF-Detector board (IF-DET) provides approximately 120 dB gain at the IF frequency, detects the audio frequencies and provides the volume squelch Hi output to the System-Audio & Squelch board (SAS). The Fl keying lead, and RX OSC control from the SAS board, compensation voltage from the exciter and the requlated +10 Volt circuits are completed through P903 and J602 on the IF-DET board.

IF-DET board 19C321662G2, G8 contains a 4-pole and a 2-pole crystal filter and operates with an IF frequency of 9.4 MHz. It is used in radios with an operating frequency of 29.7-36 MHz, 42-50 MHz and 851-870 MHz.

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IF-DET board 19C321662G3, G9 contains two 2-pole crystal filters and operates with an IF frequency of 11.2 MHz. It is used in radios with an operating frequency of 138-174 MHz, and 406-512 MHz.

CIRCUIT ANALYSIS

CRYSTAL FILTERS, IF AMP & LIMITER-DETECTOR

The IF input from the MIF or IF Filter board is applied to a monolithic crystal filter (FL601 and FL602). The crystal filter provides additional selectivity and is followed by an impedance matching network Z601 and IF amplifier U601. The IC amplifier provides approximately 60 dB gain.

Final IF selectivity is provided by two-pole crystal filter FL603. Impedance matching network Z602 matches the output impedance of IF amplifier IC U601 to the input of two-pole crystal filter FL603. The IF amplifier output is metered at J601-1 through a metering network consisting of C612, C613, CR601 and CR602. Impedance matching network Z603 matches the output impedance of FL603 to the input of Limiter-Detector IC U602.

In addition to providing 60 dB of gain at the IF frequency, Limiter-Detector IC U602, C620, C621 and L603 comprise a quadrature phase detector to recover the audio from the IF frequency. The quadrature phase detector utilizes a 90 degree phase shift in the IF frequency to detect the audio signal. It compares the phase of the IF input at U602-4 with the same IF input frequency shifted 90 degrees at U602-2. The resultant signal varies phase linearly as the carrier signal deviates about the center frequency.

The detector output is adjusted for maximum audio output by L603 and is metered at J601-2 through R607.

AUDIO PREAMPLIFIER

The audio preamplifier consists of transistors Q601, Q602, and Q603. It provides approximately 26 dB of gain.

The output of the Limiter-Detector is coupled to the audio preamplifier through audio level adjust control R608. R608 sets the audio input level to the preamplifier circuit.

The output of the audio preamplifier is coupled through a low pass filter (L604 and C626) to volume and squelch control circuit on the SAS board. The filter removes any IF signal remaining in the audio output of the preamplifier.

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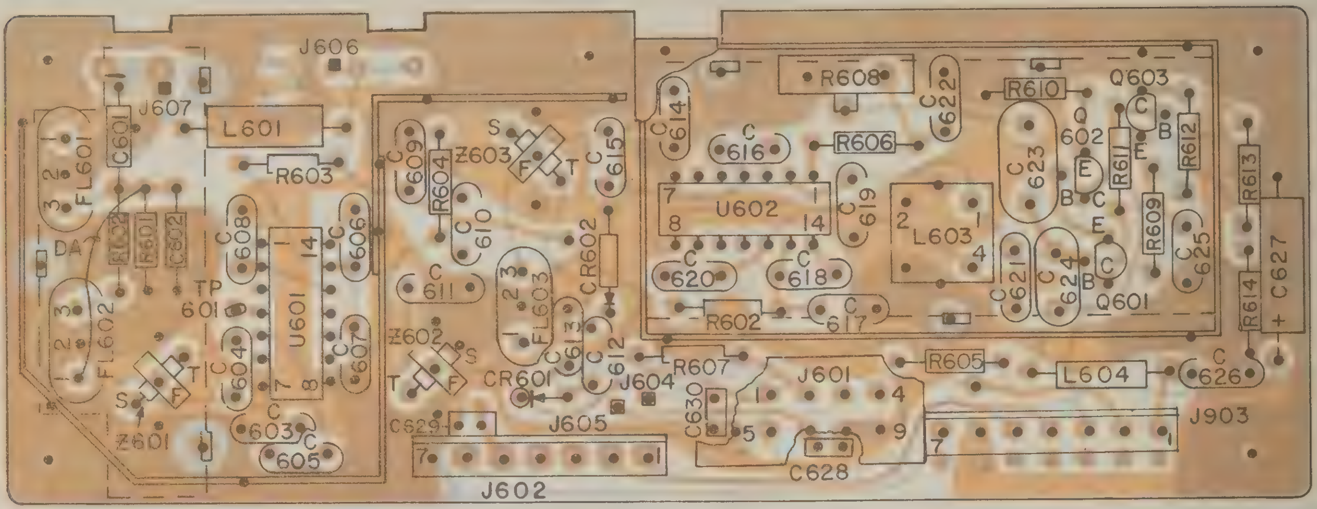
CUSTOM MVP/MONITOR RECEIVER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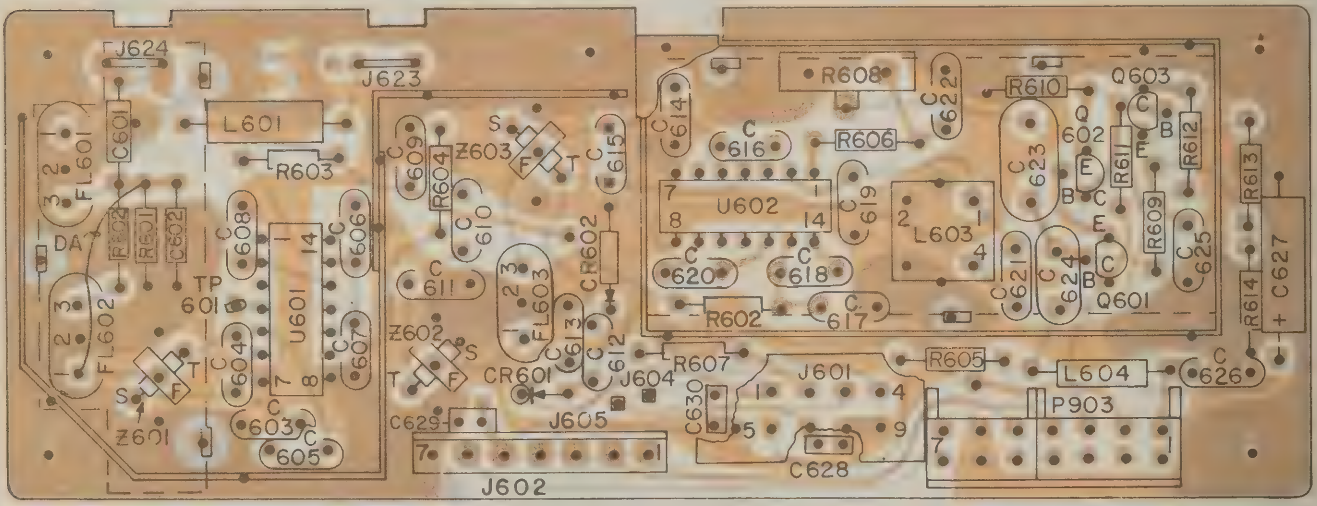
C621
C624
Q601
C627
R614
R602
C617
R607
J601
C630
R605
L604
C626
J903
C628

(19C327110, Sh. 2, Rev. 0)
(19C321673, Sh. 2, Rev. 5)
(19C321673, Sh. 3, Rev. 5)

MASTR EXECUTIVE II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C629
J602
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R608
C622
R610
Q603
Q602
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C619
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R609
C625
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C618
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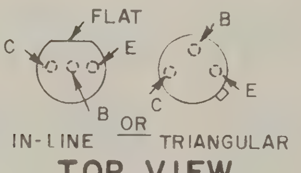
C627
R614
R602
C617
R607
J601
C630
R605
L604
C626
P903
C628

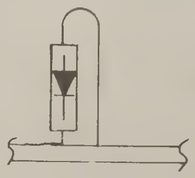
(19C327110, Sh. 1, Rev. 5)
(19C321673, Sh. 2, Rev. 5)
(19C321673, Sh. 3, Rev. 5)

LEAD IDENTIFICATION
FOR Q601, Q602, & Q603


FLAT
C
E
B
B
C
E
IN-LINE
OR
TRIANGULAR

TOP VIEW

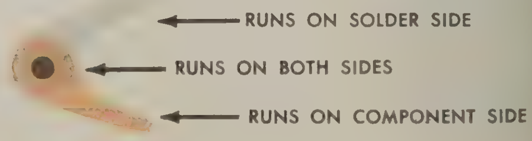
NOTE: LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION. TAB INDICATES EMITTER LEAD.



POLARITY FOR CR601

OUTLINE DIAGRAM

IF DETECTOR BOARD
19C321662G1-G3, G7-G9


RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE

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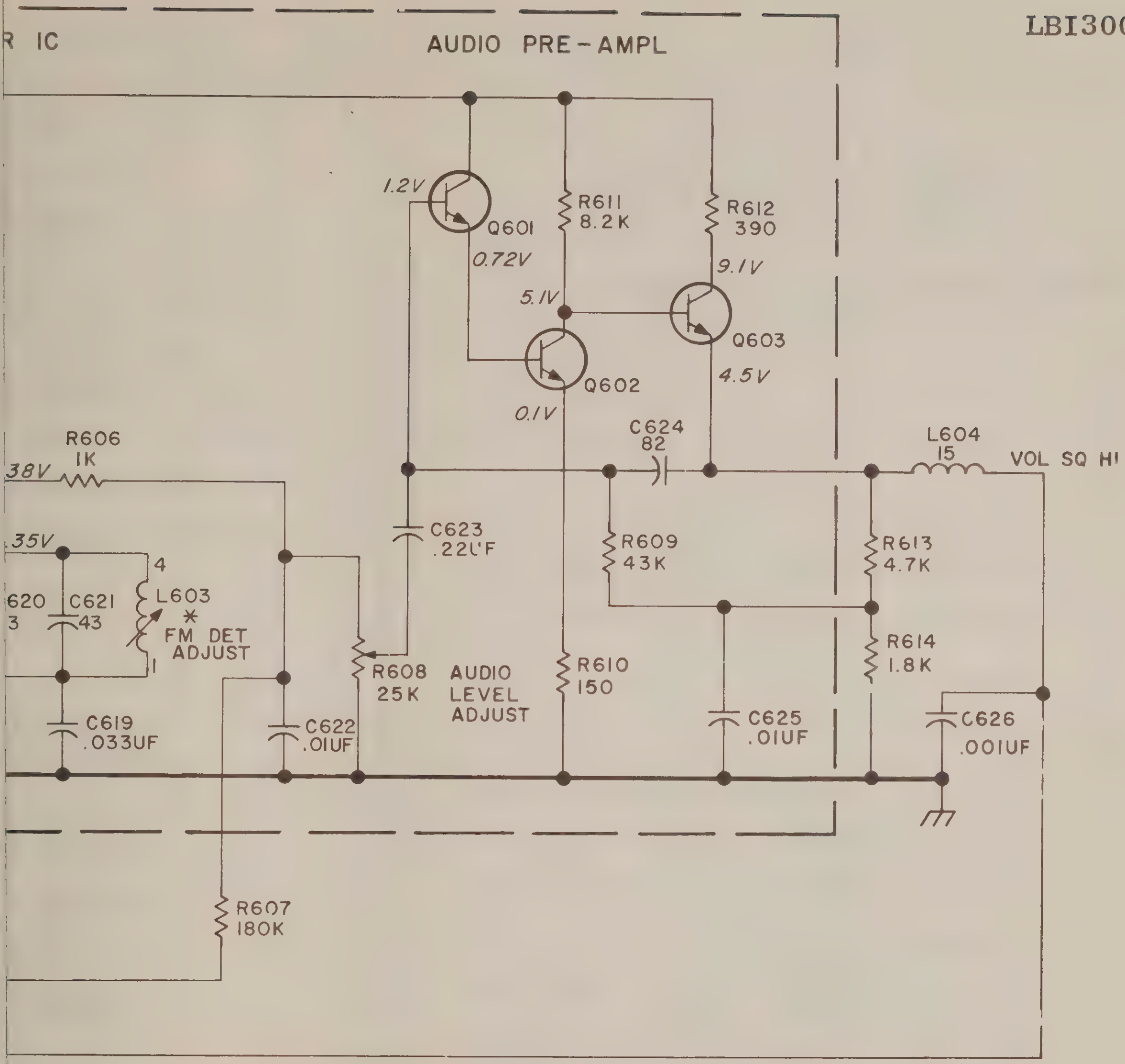

R IC
AUDIO PRE-AMPL
1.2V
Q601
0.72V
R611
8.2K
R612
390
9.1V
5.1V
Q603
Q602
4.5V
0.1V
C624
82
L604
15
VOL SQ HI
R606
1K
38V
35V
C623
.22UF
R609
43K
R613
4.7K
4
L603
*
FM DET
ADJUST
620
3
C621
43
1
R608
25K
AUDIO
LEVEL
ADJUST
R610
150
R614
1.8K
C619
.033UF
C622
.01UF
C625
.01UF
C626
.001UF
R607
180K

LE
11.2 MHz
C
.47PF
20PF
5PF
6.8
FL601C
FL603C
560

FREQ RANGE
6-42MHz, 66-88MHz
0-36MHz, 42 -50MHz 51 - 870 MHz
38-174MHz, 406 - 512MHz
6 - 42MHz, 66 - 88MHz
0-36MHz, 42-50MHz 51 - 870MHz
38 - 174 MHz, 406-512MHz

● 30-50 & 138-178 MHz NOISE BLANKER TEST POINT. 406-420 & 450-512 MHz MULT 3 TEST POINT.

■ PRESENT IN GROUPS 1, 2, 7 & 8

▲ PRESENT IN GROUPS 3 & 9

NOTES:

1. J623, J624 & P903 ARE PRESENT IN GROUPS 1, 2 & 3 ONLY FOR MASTR EXEC. II.
2. J606, J607 & J903 ARE PRESENT IN GROUPS 7, 8 & 9 ONLY FOR CUSTOM MVP

VOLTAGE READING

VOLTAGE READINGS ARE TYPICAL READINGS MEASURED TO SYSTEM NEGATIVE (P903-6) WITH TEST SET MODEL 4EX3A11 OR A 20,000 OHM-PER-VOLT METER.

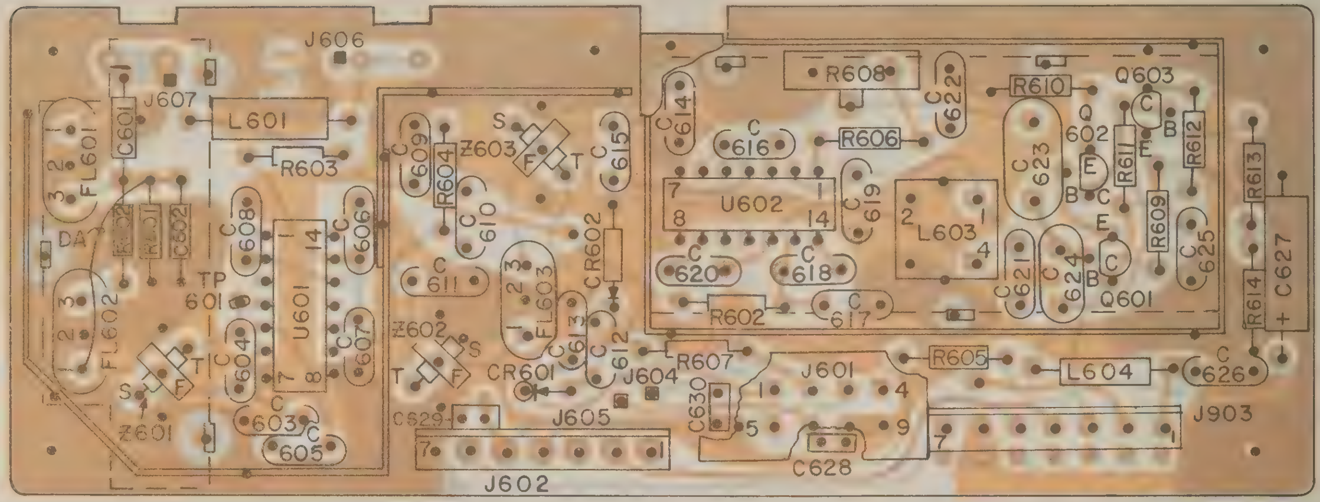
ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG = 1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.

SCHEMATIC DIAGRAM

IF DETECTOR BOARD
19C321662G1-G3, G7-G9

Issue 6

CUSTOM MVP/MONITOR RECEIVER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FL601
R603
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TP 601
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CR601
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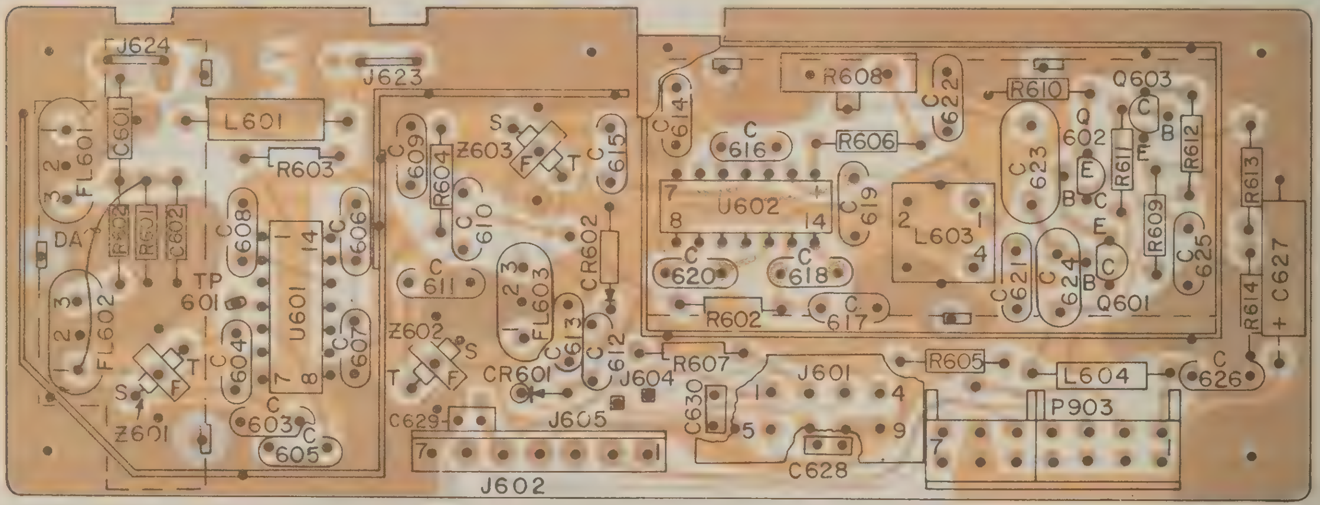
R607
C629
J605
J602
C614
R608
C622
C616
R606
U602
C619
C620
C618
R602
C617
L603
R610
Q603
Q602
C623
R611
R612
R609
C621
C624
Q601
C625
R613
R614
C627
R605
L604
C626
J601
C630
C628
J903

(19C327110, Sh. 2, Rev. 0)
(19C321673, Sh. 2, Rev. 5)
(19C321673, Sh. 3, Rev. 5)

MASTR EXECUTIVE II


J624
J623
L601
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FL601
R603
R602
R601
C602
DA
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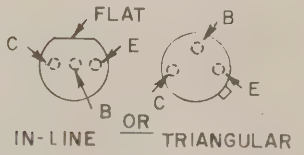
U601
C606
TP 601
FL602
C604
C607
Z601
C603
C605
C609
R604
Z603
C615
C610
C611
FL603
CR602
Z602
C613
C612
CR601
J604
R607
C629
J605
J602
C614
R608
C622
C616
R606
U602
C619
C620
C618
R602
C617
L603
R610
Q603
Q602
C623
R611
R612
R609
C621
C624
Q601
C625
R613
R614
C627
R605
L604
C626
J601
C630
C628
P903

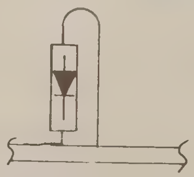
(19C327110, Sh. 1, Rev. 5)
(19C321673, Sh. 2, Rev. 5)
(19C321673, Sh. 3, Rev. 5)

LEAD IDENTIFICATION
FOR Q601, Q602, & Q603


FLAT
C
E
B
IN-LINE
OR
B
C
E
TRIANGULAR

TOP VIEW

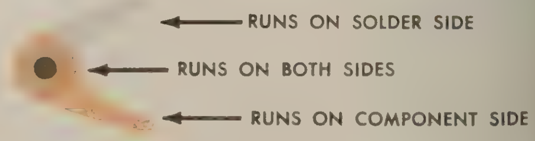
NOTE: LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION. TAB INDICATES EMITTER LEAD.



POLARITY FOR CR601

OUTLINE DIAGRAM

IF DETECTOR BOARD
19C321662G1-G3, G7-G9


RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE

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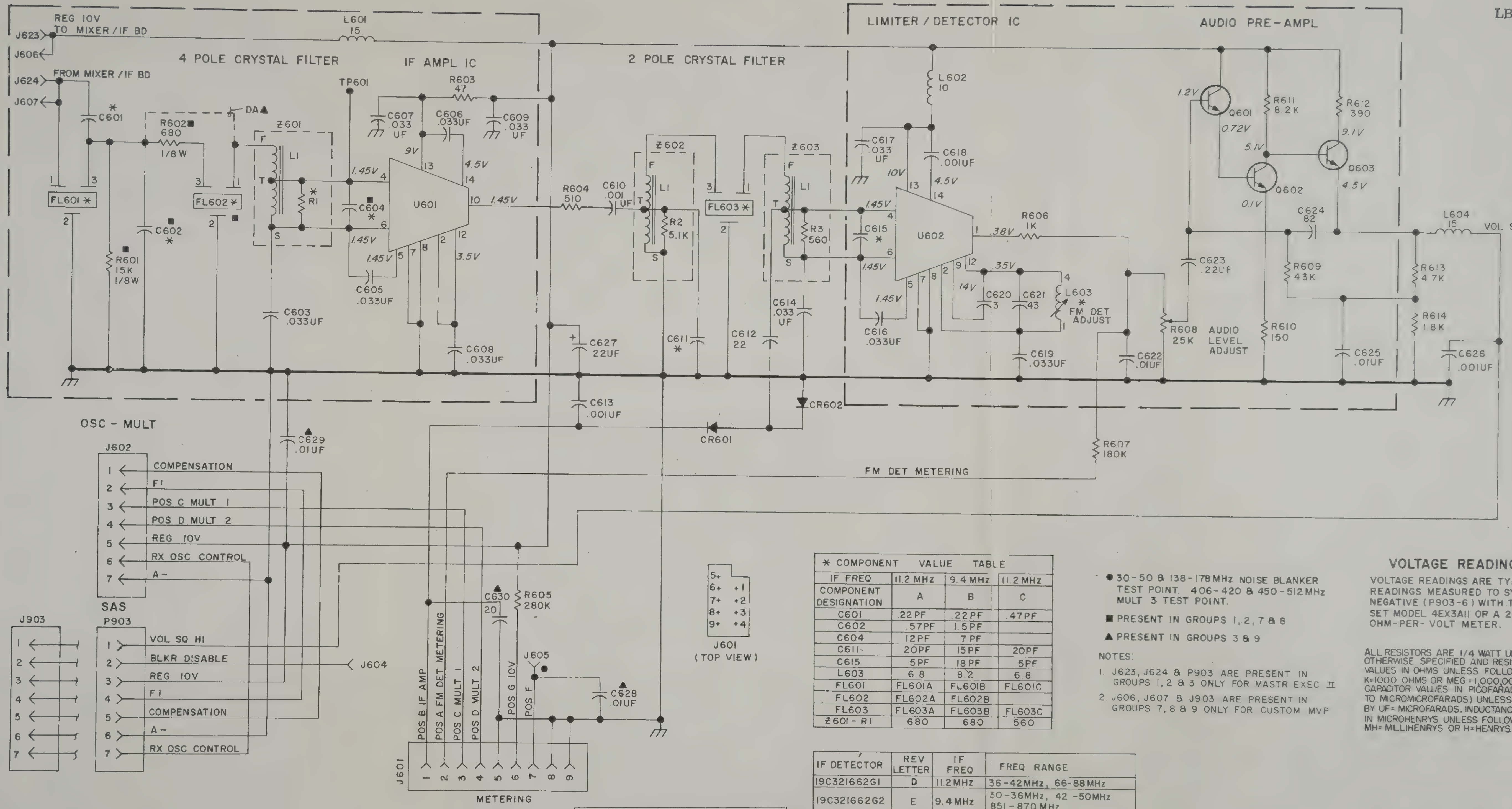
4 POLE CRYSTAL FILTER
IF AMPL IC
2 POLE CRYSTAL FILTER
LIMITER / DETECTOR IC
AUDIO PRE-AMPL
REG 10V TO MIXER / IF BD
FROM MIXER / IF BD
J623
J606
J624
J607
L601 15
L602 10
L604 15
VOL SQ HI
TP601
C601 *
R602 ■ 680 1/8W
DA ▲
Z601
L1
R1 *
FL601 *
FL602 *
FL603 *
R601 ■ 15K 1/8W
C602 *
C603 .033UF
C604 ■ *
U601
U602
R603 47
C607 .033 UF
C606 .033UF
C609 .033 UF
C605 .033UF
C608 .033UF
C627 22UF
C613 .001UF
R604 510
C610 .001 UF
Z602
R2 5.1K
Z603
R3 560
C611 *
C612 22
C614 .033 UF
CR601
CR602
C617 .033 UF
C618 .001UF
C615 *
C616 .033UF
R606 1K
C620 3
C621 43
L603 * FM DET ADJUST
C619 .033UF
C622 .01UF
R607 180K
R608 25K AUDIO LEVEL ADJUST
C623 .22UF
Q601
Q602
Q603
R611 8.2K
R612 390
R609 43K
R610 150
C624 82
C625 .01UF
R613 4.7K
R614 1.8K
C626 .001UF
FM DET METERING
OSC - MULT
J602
COMPENSATION
F1
POS C MULT 1
POS D MULT 2
REG 10V
RX OSC CONTROL
A-
C629 ▲ .01UF
SAS
P903
J903
VOL SQ HI
BLKR DISABLE
J604
C630 ▲ 20
R605 280K
J605 ●
C628 ▲ .01UF
POS B IF AMP
POS A FM DET METERING
POS C MULT 1
POS D MULT 2
POS G 10V
POS F
J601
METERING
J601 (TOP VIEW)
1.2V
0.72V
5.1V
9.1V
0.1V
4.5V
1.45V
9V
4.5V
3.5V
10V
.38V
.35V
14V

* COMPONENT VALUE TABLE			
IF FREQ	11.2 MHz	9.4 MHz	11.2 MHz
COMPONENT DESIGNATION	A	B	C
C601	.22 PF	.22 PF	.47 PF
C602	.57 PF	1.5 PF	
C604	12 PF	7 PF	
C611	20 PF	15 PF	20 PF
C615	5 PF	18 PF	5 PF
L603	6.8	8.2	6.8
FL601	FL601A	FL601B	FL601C
FL602	FL602A	FL602B	
FL603	FL603A	FL603B	FL603C
Z601 - R1	680	680	560

IF DETECTOR	REV LETTER	IF FREQ	FREQ RANGE
19C321662G1	D	11.2 MHz	36-42 MHz, 66-88 MHz
19C321662G2	E	9.4 MHz	30-36 MHz, 42-50 MHz 851-870 MHz
19C321662G3	F	11.2 MHz	138-174 MHz, 406-512 MHz
19C321662G7	–	11.2 MHz	36-42 MHz, 66-88 MHz
19C321662G8	–	9.4 MHz	30-36 MHz, 42-50 MHz 851-870 MHz
19C321662G9	–	11.2 MHz	138-174 MHz, 406-512 MHz

- ● 30-50 & 138-178 MHz NOISE BLANKER TEST POINT. 406-420 & 450-512 MHz MULT 3 TEST POINT.
- ■ PRESENT IN GROUPS 1, 2, 7 & 8
- ▲ PRESENT IN GROUPS 3 & 9

NOTES:

1. J623, J624 & P903 ARE PRESENT IN GROUPS 1, 2 & 3 ONLY FOR MASTR EXEC II
2. J606, J607 & J903 ARE PRESENT IN GROUPS 7, 8 & 9 ONLY FOR CUSTOM MVP

VOLTAGE READING

VOLTAGE READINGS ARE TYPICAL READINGS MEASURED TO SYSTEM NEGATIVE (P903-6) WITH TEST SET MODEL 4EX3A11 OR A 20,000 OHM-PER-VOLT METER.

ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF=MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH=MILLIHENRYS OR H=HENRYS.

IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.

(19D423320, Rev. 11)

SCHEMATIC DIAGRAM

IF DETECTOR BOARD
19C321662G1-G3, G7-G9

GE PART NO.	DESCRIPTION
B226649G2	Coil assembly. Includes:
152P512J	Resistor, composition: 5.1K ohms ±5%, 1/4 w.
B226649G5	Coil assembly. Includes:
152P512J	Resistor, composition: 5.1K ohms ±5%, 1/4 w.
	In REV D and earlier:
B226649G2	Coil assembly. Includes:
152P512J	Resistor, composition: 5.1K ohms ±5%, 1/4 w.
B226649G2	Coil assembly. Includes:
152P512J	Resitor, composition: 5.1K ohms ±5%, 1/4 w.
B226649G3	Coil assembly. Includes:
152P561J	Resistor, composition: 560 ohms ±5%, 1/4 w.
B226649G6	Coil assembly. Includes:
152P561J	Resistor, composition: 560 ohms ±5%, 1/4 w.
	In REV D and earlier:
B226649G3	Coil assembly. Includes:
152P561J	Resistor, composition: 560 ohms ±5%, 1/4 w.
B226649G3	Coil assembly. Includes:
152P561J	Resistor, composition: 560 ohms ±5%, 1/4 w.
	- - - - - - - - - MISCELLANEOUS - - - - - - - -
B226648G1	Shield. (Located around FL601, FL602).
B219571G1	Shield. (Located under Z601, J624 on opposite side of component board).
B219554G1	Can. (Located around U602, Q603)
B219555P1	Cover. (Used with 19B219554G1 can).
B219727G1	Shield. (Located under 19B219554G1 can).
A116428P4	Ground tab; sim to AMP 86031-1 (Strip Form). (Used with shields on bottom of circuit board).
C327289P1	Bottom Cover. (IF Detector- 25-512 MHz).
C321744P1	Bottom Cover. (IF Detector- 806-870 MHz).

PRODUCTION CHANGES

Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter", which is stamped after the model number of the unit. The revision stamped on the unit includes all previous revisions. Refer to the Parts List for descriptions of parts affected by these revisions.

REV. A - IF Detector Board 19C321662G1-3

To improve IF stability.
Changed C613.

REV. C - IF Detector Board 19C321662G3

To improve IF tuning. Added C628, C629 and C630.

REV. B - IF Detector Board 19C321662G1, 2

REV. D - IF Detector Board 19C321662G3

To make compatable for Custom MVP applications.
Added J606 and J607.

REV. C - IF Detector Board 19C321662G1

REV. E - IF Detector Board 19C321662G3

To improve operation. Changed FL601C and FL603A.

REV. C - IF Detector Board 19C321662G2

To improve IF response. Changed C615B.

REV. D - IF Detector Board 19C321662G1, 2

REV. F - IF Detector Board 19C321662G3

To improve operation. Changed C620 and C621.

REV. E - IF Detector Board 19C321662G2

To improve IF response. Changed C604B, C611B, C615B, Z601, Z602 and Z603.

ADDENDUM #1 TO LBI30049E

This addendum contains information on IF-Detector board 19D432538G1-G6. The IF-Det board used tuneable IF transformers to facilitate alignment and troubleshooting. Changes in the IF alignment and circuit analysis of the IF-Det board are contained in this addendum.

DESCRIPTION

The IF-Detector board (IF-DET) provides approximately 120 dB gain at the IF frequency, detects the audio frequencies and provides the volume squelch Hi output to the System-Audio & Squelch board (SAS). The F1 keying lead, and RX OSC control from the SAS board, compensation voltage from the exciter and the regulated +10 Volt circuits are completed through P903/J903 and J602 on the IF-DET board.

IF-DET board 19D432538G2 and G5 contains a 4-pole and a 2-pole crystal filter and operates with an IF frequency of 9.4 MHz. It is used in radios with an operating frequency of 29.7-36 MHz, 42-50 MHz and 851-870 MHz.

IF-DET board 19D432538G1 and G4 also contains a 4-pole and a 2-pole crystal filter. It operates with an IF frequency of 11.2 MHz and is used in radios with an operating frequency between 36-42 MHz and 66-88 MHz.

IF-DET board 19D432538G3 and G6 contains two 2-pole crystal filters and operates with an IF frequency of 11.2 MHz. It is used in radios with an operating frequency of 138-174 MHz, and 406-512 MHz.

CIRCUIT ANALYSIS

CRYSTAL FILTERS, IF AMP & LIMITER-DETECTOR

The IF input from the MIF or IF Filter board is applied to monolithic crystal filter FL601 and FL602. The cyrstal filter provides additional selectivity and is followed by a tuneable impedance matching network (T601) and IF amplifier U601. The IC amplifier provides approximately 60 dB gain.

Final IF selectivity is provided by two-pole crystal filter FL603. A tuneable impedance matching network T602 matches the output impedance of IF amplifier IC U601 to the input of crystal filter FL603. The IF amplifier output is metered at J601-1 through a metering network consisting of C612, C613, CR601 and CR602. Tuneable impedance matching network T603 matches the output impedance of FL603 to the input of Limiter-Detector IC U602.

In addition to providing 60 dB of gain at the IF frequency, Limiter-Detector IC U602, C620, C621 and L603 comprise a quadrature phase detector to recover the audio from the IF frequency. The quadrature phase detector utilizes a 90 degree phase shift in the IF frequency to detect the audio signal. It compares the phase of the IF input at U602-4 with the same IF input frequency shifted 90 degrees at U602-2. The resultant signal varies phase linearly as the carrier signal deviates about the center frequency.

The detector output is adjusted for maximum audio output by FM DET ADJUST T604, and is metered at J601-2 through R607.

AUDIO PREAMPLIFIER

The audio preamplifier consists of transistors Q601, Q602, and Q603. It provides approximately 26 dB of gain.

The output of the Limiter-Detector is coupled to the audio preamplifier through audio level adjust control R608. R608 sets the audio input level to the preamplifier circuit.

The output of the audio preamplifier is coupled through a low pass filter (L604 and C626) to volume and squelch control circuit on the SAS board. The filter removes any IF signal remaining in the audio output of the preamplifier.

ALIGNMENT CHANGES

FM DETECTOR

When adjusting the FM detector, substitute T604 for L603 in the Complete Receiver Alignment.

IF-DETECTOR

After completing the Mixer-IF alignment steps, set cores of T601, T602 and T603 to top of coil form. Then tune T601, T602 and T603 for double trace as shown on scope pattern in the Complete Receiver Alignment. Reduce generator output as required to keep full waveform on scope.

GENERAL ELECTRIC COMPANY • MOBILE COMMUNICATIONS DIVISION
WORLD HEADQUARTERS • LYNCHBURG, VIRGINIA 24502 U.S.A.

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PARTS LIST

LBI30081E

IF DETECTOR BOARD
19C321662G1 36-42 MHz (IF 11.2 MHz)
19C321662G2 30-36, 42-50 MHz (IF 9.2 MHz)
19C321662G3 138-174, 406-512 MHz (IF 11.2 MHz)
19C321662G7 36-42 MHz (IF 11.2 MHz)
19C321662G8 30-36, 42-50 MHz (IF 9.2 MHz)
19C321662G9 138-174, 406-512 MHz (IF 11.2 MHz)

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - - CAPACITORS - - - - - - - - - -
C601A and C601B	5491601P105	Phenolic: 0.22 pf ±5%, 500 VDCW.
C601C	5491601P113	Phenolic: 0.47 pf ±5%, 500 VDCW.
C602A	5491601P115	Phenolic: 0.56 pf ±5%, 500 VDCW.
C602B	5491601P123	Phenolic: 1.5 pf ±5%, 500 VDCW.
C603	19A116080P104	Polyester: 0.033 µf ±10%, 50 VDCW.
C604A	5496219P642	Ceramic disc: 12 pf ±5%, 500 VDCW, temp coef -470 PPM.
C604B*	5496219P638	Ceramic disc: 7.0 pf ±0.25 pf, 500 VDCW, temp coef -470 PPM.
		In REV D and earlier:
	5496219P647	Ceramic disc: 22 pf ±5%, 500 VDCW, temp coef -470 PPM.
C605 thru C609	19A116080P104	Polyester: 0.033 µf ±10%, 50 VDCW.
C610	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C611A	5496219P646	Ceramic disc: 20 pf ±5%, 500 VDCW, temp coef -470 PPM.
C611B*	5496219P644	Ceramic disc: 15 pf ±5%, 500 VDCW, temp coef -470 PPM.
		In REV D and earlier:
	5496219P649	Ceramic disc: 27 pf ±5%, 500 VDCW, temp coef -470 PPM.
C611C	5496219P646	Ceramic disc: 20 pf ±5%, 500 VDCW, temp coef -470 PPM.
C612	5496219P647	Ceramic disc: 22 pf ±5%, 500 VDCW, temp coef -470 PPM.
C613*	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
		Earlier than REV A:
	5494481P101	Ceramic disc: 150 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C614	19A116080P104	Polyester: 0.033 µf ±10%, 50 VDCW.
C615A	5496219P636	Ceramic disc: 5.0 pf ±0.25 pf, 500 VDCW, temp coef -470 PPM.
C615B*	5496219P645	Ceramic disc: 18 pf ±5%, 500 VDCW, temp coef -470 PPM.
		In REV C and D:
	5496219P649	Ceramic disc: 27 pf ±5%, 500 VDCW, temp coef -470 PPM.
		In REV B and earlier:
	5496219P645	Ceramic disc: 18 pf ±5%, 500 VDCW, temp coef -470 PPM.
C615C	5496219P636	Ceramic disc: 5.0 pf ±0.25 pf, 500 VDCW, temp coef -470 PPM.
C616 and C617	19A116080P104	Polyester: 0.033 µf ±10%, 50 VDCW.
C618	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C619	19A116080P104	Polyester: 0.033 µf ±10%, 50 VDCW.
C620*	19A116656P3J1	Ceramic disc: 3.0 pf ±0.5 pf, 500 VDCW, temp coef -150 PPM.
		In G1, G2 of REV C and earlier: In G3 of REV E and earlier:
	5496219P334	Ceramic disc: 3.0 pf ±0.25 pf, 500 VDCW, temp coef -150 PPM.
C621*	19A116656P43J1	Ceramic disc: 43 pf ±5%, 500 VDCW, temp coef -150 PPM.
		In G1, G2 of REV C and earlier: In G3 of REV E and earlier:
	5496219P354	Ceramic disc: 43 pf ±5%, 500 VDCW, temp coef -150 PPM.
C622	19A116080P101	Polyester: 0.01 µf ±10%, 50 VDCW.
C623	19A116080P109	Polyester: 0.22 µf ±10%, 50 VDCW.
C624	7489162P25	Silver mica: 82 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C625	19A116080P101	Polyester: 0.01 µf ±10%, 50 VDCW.
C626	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C627	5496267P10	Tantalum: 22 µf ±20%, 15 VDCW; sim to Sprague Type 150D.
C628* and C629*	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121 SPECIAL. Added to G3 by REV C.
C630*	19A116114P39	Ceramic: 20 pf ±5%, 100 VDCW; temp coef 0 PPM. Added to G3 by REV C.
		- - - - - - - - DIODES AND RECTIFIERS - - - - - - -
CR601 and CR602	4038056P1	Germanium.
		- - - - - - - - - - - - - FILTERS - - - - - - - - - -
FL601A	19B219573G3	Crystal, freq: Resonator A: 11,200000 KHz, Resonator B: 11,196024 KHz. Resonator A: 11,200000 KHz, Resonator B: 11,196024 KHz.
FL601B	19B219574G3	Crystal freq: Resonator A: 9400.300 KHz, Resonator B: 9396.324 KHz. Resonator A: 9400.300 KHz, Resonator B: 9396.324 KHz.
FL601C*	19B219573G6	Crystal freq: Resonator A: 11,200000 KHz, Resonator B: 11,200000 KHz.
		In G1 of REV B and earlier: In G3 of REV D and earlier:
	19B219573G1	Crystal freq: Resonator A: 11,200000 KHz, Resonator B: 11,200000 KHz.
FL602A		(Part of FL601A).
FL602B		(Part of FL601B).
FL603A*	19B219573G6	Crystal freq: Resonator A: 11,200000 KHz, Resonator B: 11,200000 KHz.
		In G1 of REV B and earlier: In G3 of REV D and earlier:
	19B219573G1	Crystal freq: Resonator A: 11,200000 KHz, Resonator B: 11,200000 KHz.
FL603B	19B219574G1	Crystal freq: Resonator A: 9400.300 KHz, Resonator B: 9400.300 KHz.
FL603C	19B219573G6	Crystal freq: Resonator A: 11,200000 KHz, Resonator B: 11,200000 KHz.
		- - - - - - - JACKS AND RECEPTACLES - - - - - -
J601	19B219374G1	Connector. Includes:
	19C317957P1	Shell.
	19A116651P1	Contact, electrical; sim to Malco X0-2864.
J602	19A116659P106	Connector, printed wiring: 7 contacts; sim to Molex 09-60-1071.
J604 and J605	19A116779P1	Contact, electrical; sim to Molex 08-50-0404.
J606* and J607*	19A116779P1	Contact, electrical; sim to Molex 08-50-0404. Added to G1, G2 by REV B. Added to G3 by REV D.
J623 and J624	19A116975P1	Contact, electrical.
J903	19A116659P106	Connector, printed wiring: 7 contacts; sim to Molex 09-60-1071.
		- - - - - - - - - - - INDUCTORS - - - - - - - - - - -
L601	7488079P18	Choke, RF: 15.0 µh ±10%, 1.20 ohms DC res max; sim to Jeffers 4421-9K.
L602	19B209420P125	Coil, RF: 10.0 µh ±10%, 3.10 ohms DC res max; sim to Jeffers 4446-4K.
L603A	19C311181G13	Coil.
L603B	19C311181G14	Coil.
L603C	19C311181G13	Coil.
L604	7488079P18	Choke, RF: 15.0 µh ±10%, 1.20 ohms DC res max; sim to Jeffers 4421-9K.
		- - - - - - - - - - - - PLUGS - - - - - - - - - - -
P903		Connector. Includes:
	19A116659P1	Connector, printed wiring: 3 contacts; sim to Molex 09-52-3032.
	19A116659P15	Connector, printed wiring: 4 contacts; sim to Molex 09-52-3042.
		- - - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q601 thru Q603	19A115910P1	Silicon, NPN; sim to Type 2N3904.
		- - - - - - - - - - - RESISTORS - - - - - - - - - - -
R601	3R151P153J	Composition: 15K ohms ±5%, 1/8 w.
R602	3R151P681J	Composition: 680 ohms ±5%, 1/8 w.
R603	3R152P470K	Composition: 47 ohms ±10%, 1/4 w.
R604	3R152P511J	Composition: 510 ohms ±5%, 1/4 w.
R605	19C314256P22803	Metal film: 280K ohms ±1%, 1/4 w.
R606	3R152P102K	Composition: 1K ohms ±10%, 1/4 w.
R607	3R152P184J	Composition: 0.18 megohm ±5%, 1/4 w.
R608	19B209358P107	Variable, carbon film: approx 800 to 25K ohms ±10%, 0.25 w; sim to CTS Type X-201.
R609	3R152P433J	Composition: 43K ohms ±5%, 1/4 w.
R610	3R152P151J	Composition: 150 ohms ±5%, 1/4 w.
R611	3R152P822K	Composition: 8.2K ohms ±10%, 1/4 w.
R612	3R152P391J	Composition: 390 ohms ±5%, 1/4 w.
R613	3R152P472J	Composition: 4.7K ohms ±5%, 1/4 w.
R614	3R152P182J	Composition: 1.8K ohms ±5%, 1/4 w.
		- - - - - - - - - - TEST POINTS - - - - - - - - - -
TP601	N503P304F15	Cotter pin.
		- - - - - - - INTEGRATED CIRCUITS - - - - - - -
U601 and U602	19A116445P1	Integrated circuit, linear: sim to ULN 2111.
		- - - - - - - - - - - NETWORKS - - - - - - - - - -
Z601A	19B226649G1	Coil assembly. Includes:
R1	3R152P681J	Resistor, composition: 680 ohms ±5%, 1/4 w.
Z601B*	19B226649G4	Coil assembly. Includes:
R1	3R152P681J	Resistor, composition: 680 ohms ±5%, 1/4 w.
		In REV D and earlier:
	19B226649G1	Coil assembly. Includes:
R1	3R152P681J	Resistor, composition: 680 ohms ±5%, 1/4 w.
Z601C	19B226649G3	Coil assembly. Includes:
R3	3R152P561J	Resistor, composition: 560 ohms ±5%, 1/4 w.
Z602A	19B226649G2	Coil assembly. Includes:
R2	3R152P512J	Resistor, composition: 5.1K ohms ±5%, 1/4 w.
Z602B*	19B226649G5	Coil assembly. Includes:
R2	3R152P512J	Resistor, composition: 5.1K ohms ±5%, 1/4 w.
		In REV D and earlier:
	19B226649G2	Coil assembly. Includes:
R2	3R152P512J	Resistor, composition: 5.1K ohms ±5%, 1/4 w.
Z602C	19B226649G2	Coil assembly. Includes:
R2	3R152P512J	Resitor, composition: 5.1K ohms ±5%, 1/4 w.
Z603A	19B226649G3	Coil assembly. Includes:
R3	3R152P561J	Resistor, composition: 560 ohms ±5%, 1/4 w.
Z603B*	19B226649G6	Coil assembly. Includes:
R3	3R152P561J	Resistor, composition: 560 ohms ±5%, 1/4 w.
		In REV D and earlier:
	19B226649G3	Coil assembly. Includes:
R3	3R152P561J	Resistor, composition: 560 ohms ±5%, 1/4 w.
Z603C	19B226649G3	Coil assembly. Includes:
R3	3R152P561J	Resistor, composition: 560 ohms ±5%, 1/4 w.
		- - - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19B226648G1	Shield. (Located around FL601, FL602).
	19B219571G1	Shield. (Located under Z601, J624 on opposite side of component board).
	19B219554G1	Can. (Located around U602, Q603)
	19B219555P1	Cover. (Used with 19B219554G1 can).
	19B219727G1	Shield. (Located under 19B219554G1 can).
	19A116428P4	Ground tab; sim to AMP 86031-1 (Strip Form). (Used with shields on bottom of circuit board).
	19C327289P1	Bottom Cover. (IF Detector- 25-512 MHz).
	19C321744P1	Bottom Cover. (IF Detector- 806-870 MHz).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

PRODUCTION CHANGES

Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter", which is stamped after the model number of the unit. The revision stamped on the unit includes all previous revisions. Refer to the Parts List for descriptions of parts affected by these revisions.

REV. A - IF Detector Board 19C321662G1-3
To improve IF stability.
Changed C613.

REV. C - IF Detector Board 19C321662G3
To improve IF tuning. Added C628, C629 and C630.

REV. B - IF Detector Board 19C321662G1, 2

REV. D - IF Detector Board 19C321662G3
To make compatable for Custom MVP applications.
Added J606 and J607.

REV. C - IF Detector Board 19C321662G1

REV. E - IF Detector Board 19C321662G3
To improve operation. Changed FL601C and FL603A.

REV. C - IF Detector Board 19C321662G2
To improve IF response. Changed C615B.

REV. D - IF Detector Board 19C321662G1, 2

REV. F - IF Detector Board 19C321662G3
To improve operation. Changed C620 and C621.

REV. E - IF Detector Board 19C321662G2
To improve IF response. Changed C604B, C611B, C615B, Z601, Z602 and Z603.

ADDENDUM #1 TO LBI30049E

This addendum contains information on IF-Detector board 19D432538G1-G6. The IF-Det board used tuneable IF transformers to facilitate alignment and troubleshooting. Changes in the IF alignment and circuit analysis of the IF-Det board are contained in this addendum.

DESCRIPTION

The IF-Detector board (IF-DET) provides approximately 120 dB gain at the IF frequency, detects the audio frequencies and provides the volume squelch Hi output to the System-Audio & Squelch board (SAS). The F1 keying lead, and RX OSC control from the SAS board, compensation voltage from the exciter and the regulated +10 Volt circuits are completed through P903/J903 and J602 on the IF-DET board.

IF-DET board 19D432538G2 and G5 contains a 4-pole and a 2-pole crystal filter and operates with an IF frequency of 9.4 MHz. It is used in radios with an operating frequency of 29.7-36 MHz, 42-50 MHz and 851-870 MHz.

IF-DET board 19D432538G1 and G4 also contains a 4-pole and a 2-pole crystal filter. It operates with an IF frequency of 11.2 MHz and is used in radios with an operating frequency between 36-42 MHz and 66-88 MHz.

IF-DET board 19D432538G3 and G6 contains two 2-pole crystal filters and operates with an IF frequency of 11.2 MHz. It is used in radios with an operating frequency of 138-174 MHz, and 406-512 MHz.

CIRCUIT ANALYSIS

CRYSTAL FILTERS, IF AMP & LIMITER-DETECTOR

The IF input from the MIF or IF Filter board is applied to monolithic crystal filter FL601 and FL602. The cyrstal filter provides additional selectivity and is followed by a tuneable impedance matching network (T601) and IF amplifier U601. The IC amplifier provides approximately 60 dB gain.

Final IF selectivity is provided by two-pole crystal filter FL603. A tuneable impedance matching network T602 matches the output impedance of IF amplifier IC U601 to the input of crystal filter FL603. The IF amplifier output is metered at J601-1 through a metering network consisting of C612, C613, CR601 and CR602. Tuneable impedance matching network T603 matches the output impedance of FL603 to the input of Limiter-Detector IC U602.

In addition to providing 60 dB of gain at the IF frequency, Limiter-Detector IC U602, C620, C621 and L603 comprise a quadrature phase detector to recover the audio from the IF frequency. The quadrature phase detector utilizes a 90 degree phase shift in the IF frequency to detect the audio signal. It compares the phase of the IF input at U602-4 with the same IF input frequency shifted 90 degrees at U602-2. The resultant signal varies phase linearly as the carrier signal deviates about the center frequency.

The detector output is adjusted for maximum audio output by FM DET ADJUST T604, and is metered at J601-2 through R607.

AUDIO PREAMPLIFIER

The audio preamplifier consists of transistors Q601, Q602, and Q603. It provides approximately 26 dB of gain.

The output of the Limiter-Detector is coupled to the audio preamplifier through audio level adjust control R608. R608 sets the audio input level to the preamplifier circuit.

The output of the audio preamplifier is coupled through a low pass filter (L604 and C626) to volume and squelch control circuit on the SAS board. The filter removes any IF signal remaining in the audio output of the preamplifier.

ALIGNMENT CHANGES

FM DETECTOR

When adjusting the FM detector, substitute T604 for L603 in the Complete Receiver Alignment.

IF-DETECTOR

After completing the Mixer-IF alignment steps, set cores of T601, T602 and T603 to top of coil form. Then tune T601, T602 and T603 for double trace as shown on scope pattern in the Complete Receiver Alignment. Reduce generator output as required to keep full waveform on scope.

GENERAL ELECTRIC COMPANY • MOBILE COMMUNICATIONS DIVISION
WORLD HEADQUARTERS • LYNCHBURG, VIRGINIA 24502 U.S.A.

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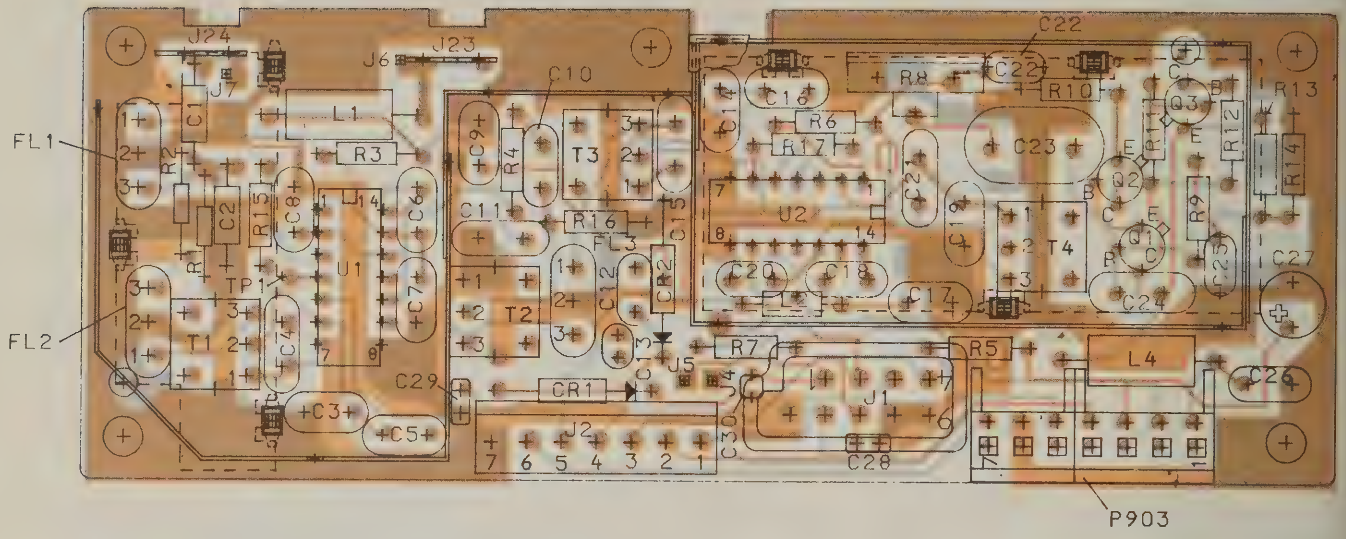
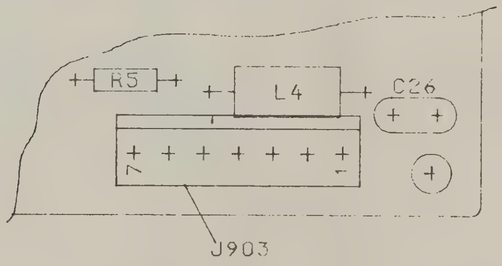
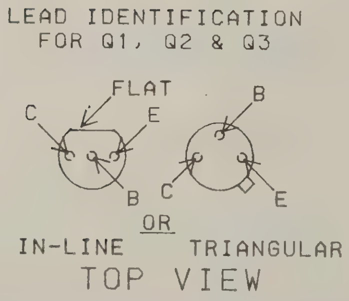
MASTR EXECUTIVE II


J24
J23
J6
J7
C1
L1
R3
C10
C22
R8
R10
R13
Q3
C16
R6
R17
C23
FL1
R2
C2
R15
C8
U1
C6
C9
R4
T3
C14
C15
C11
R16
FL3
U2
C21
C19
Q2
R11
R12
R14
T4
Q1
R9
C25
C27
TP1
T1
C4
C7
T2
C12
CR2
C20
C18
L2
C17
C24
FL2
C29
CR1
J5
R7
J4
R5
L4
C26
J1
C3
C5
J2
C30
C28
P903

(19A143462, Sh. 1, Rev. 0)
(19A143462, Sh. 2, Rev. 0)

CUSTOM


R5
L4
C26
J903

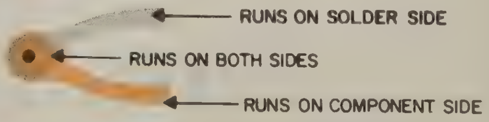

LEAD IDENTIFICATION
FOR Q1, Q2 & Q3
FLAT
C
E
B
B
C
E
OR
IN-LINE
TRIANGULAR
TOP VIEW

NOTE: LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

(19D432539, Rev. 0)

OUTLINE DIAGRAM

IF DETECTOR BOARD
19D432538G1-G6


RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE

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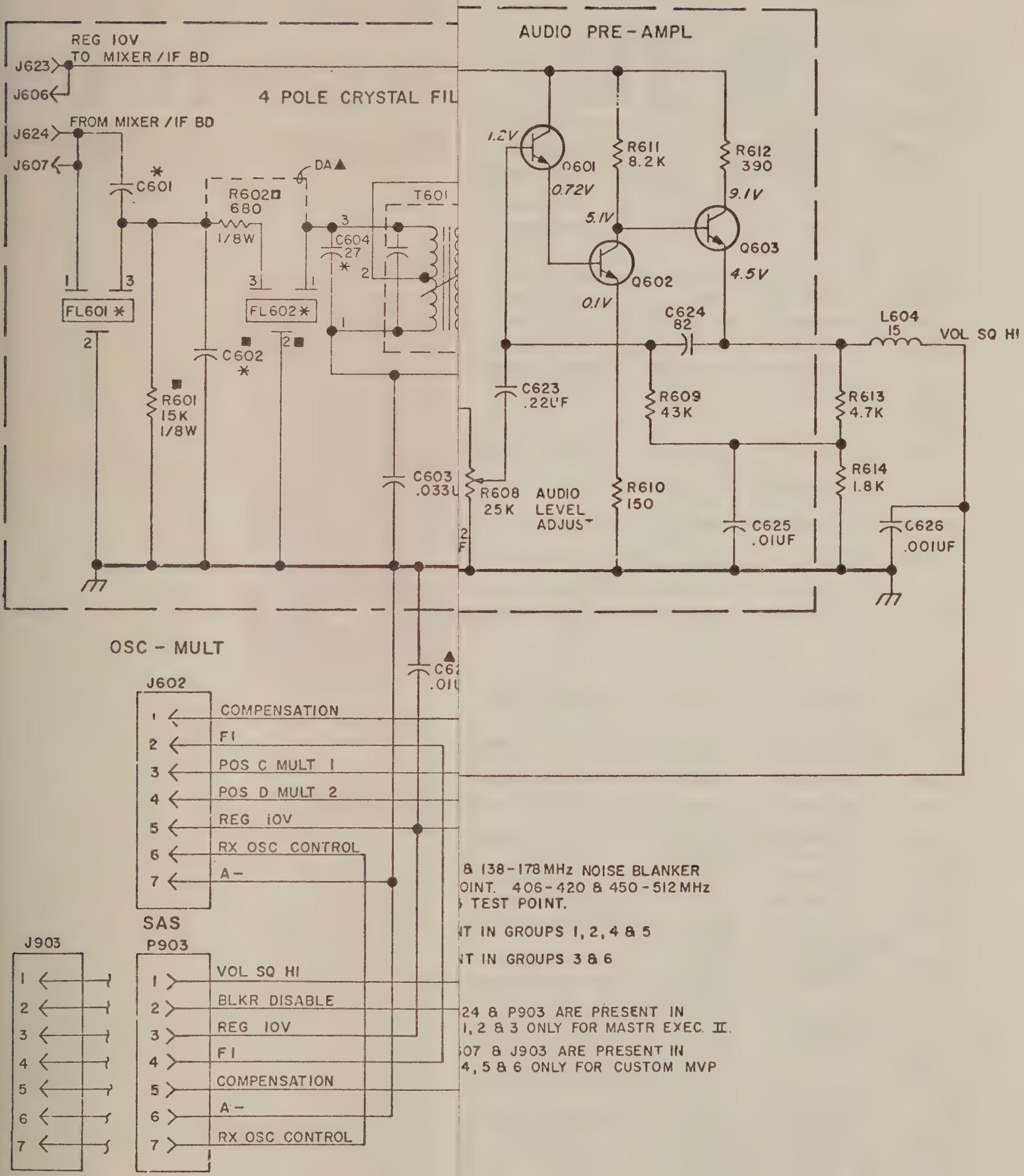

AUDIO PRE-AMPL
REG 10V
TO MIXER / IF BD
J623
J606
4 POLE CRYSTAL FIL
FROM MIXER / IF BD
J624
J607
C601 *
DA ▲
R602 ■
680
1/8W
C604
27 *
T601
FL601 *
FL602 *
C602 *
R601 ■
15K
1/8W
C603
.033U
R608
25K
AUDIO LEVEL ADJUST
1.2V
Q601
0.72V
R611
8.2K
5.1V
Q602
0.1V
R612
390
9.1V
Q603
4.5V
C624
82
C623
.22UF
R609
43K
R610
150
C625
.01UF
L604
15
VOL SQ HI
R613
4.7K
R614
1.8K
C626
.001UF
C62 ▲
.01U
OSC - MULT
J602
1 COMPENSATION
2 F1
3 POS C MULT 1
4 POS D MULT 2
5 REG 10V
6 RX OSC CONTROL
7 A-
SAS
J903
P903
1 VOL SQ HI
2 BLKR DISABLE
3 REG 10V
4 F1
5 COMPENSATION
6 A-
7 RX OSC CONTROL

& 138-178 MHz NOISE BLANKER
OINT. 406-420 & 450-512 MHz
TEST POINT.

IT IN GROUPS 1, 2, 4 & 5

IT IN GROUPS 3 & 6

24 & P903 ARE PRESENT IN
1, 2 & 3 ONLY FOR MASTR EXEC. II.

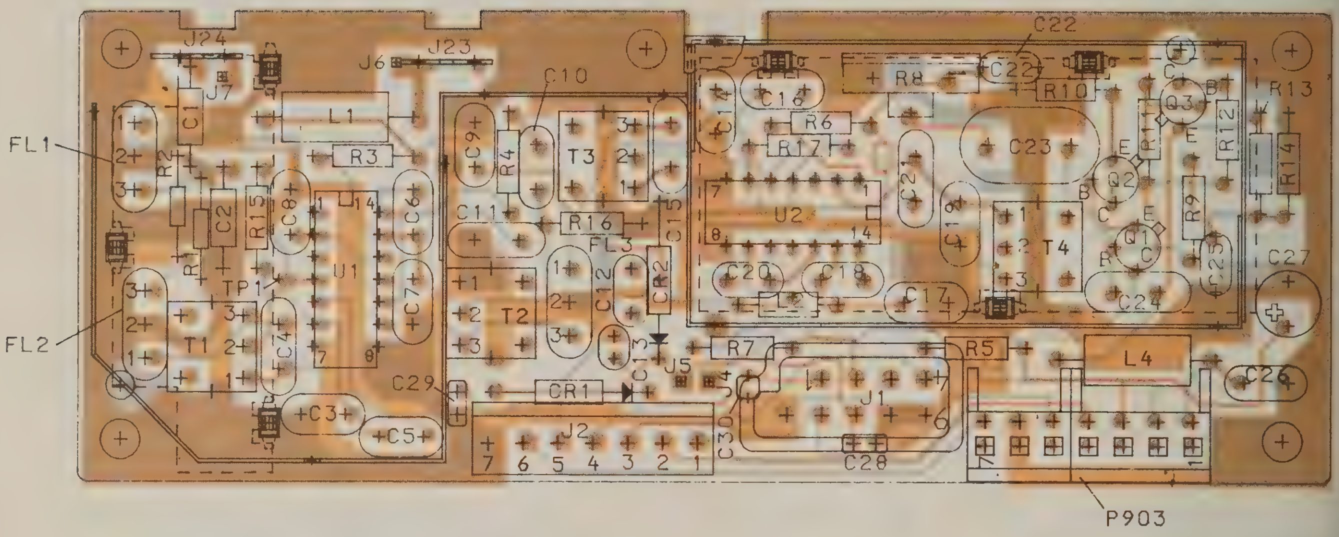
07 & J903 ARE PRESENT IN
4, 5 & 6 ONLY FOR CUSTOM MVP

ALL RESISTORS ARE 1/4 WATT
OTHERWISE SPECIFIED AND RE
VALUES IN OHMS UNLESS FOL
K=1000 OHMS OR MEG = 1,000,
CAPACITOR VALUES IN PICOFA
TO MICROMICROFARADS) UNLES
BY UF= MICROFARADS. INDUCTAN
IN MICROHENRYS UNLESS FOLL
MH= MILLIHENRYS OR H=HENRY

SCHEMATIC DIAGRAM

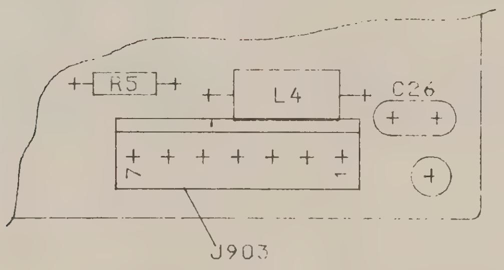
IF DETECTOR BOARD
19D432538G1-G6

MASTR EXECUTIVE II

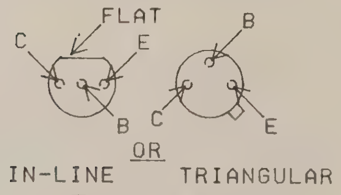

J24
J23
J6
J7
C22
C10
FL1
FL2
L1
R3
R2
C1
C2
R1
R15
C8
U1
C6
C7
TP1
T1
C4
C3
C5
C9
R4
T3
C11
R16
FL3
C15
T2
C12
CR2
C13
J5
C29
CR1
J2
C30
J4
C14
C16
R6
R17
R8
R10
Q3
R13
R11
R12
R14
C23
C21
Q2
U2
C19
T4
Q1
R9
C25
C20
C18
L2
C17
C24
C27
R7
R5
L4
J1
C26
C28
P903

(19A143462, Sh. 1, Rev. 0)
(19A143462, Sh. 2, Rev. 0)

CUSTOM


R5
L4
C26
J903

LEAD IDENTIFICATION
FOR Q1, Q2 & Q3


FLAT
C
E
B
B
C
E
OR
IN-LINE
TRIANGULAR

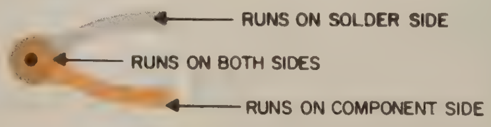
TOP VIEW

NOTE: LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

(19D432539, Rev. 0)

OUTLINE DIAGRAM

IF DETECTOR BOARD
19D432538G1-G6


RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE

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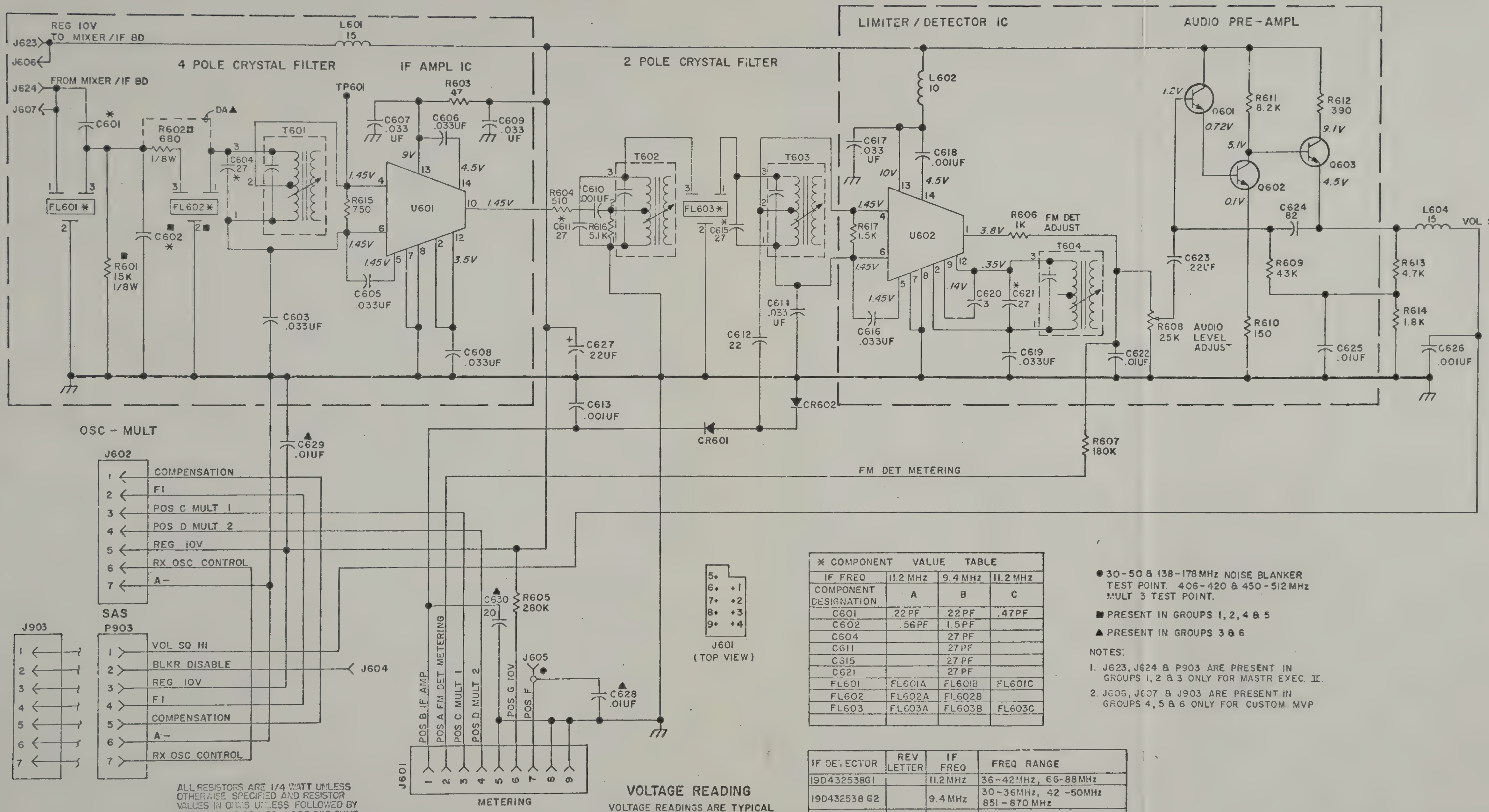
REG 10V TO MIXER / IF BD
J623
J606
FROM MIXER / IF BD
J624
J607
L601 15
4 POLE CRYSTAL FILTER
IF AMPL IC
2 POLE CRYSTAL FILTER
LIMITER / DETECTOR IC
AUDIO PRE-AMPL
TP601
DA▲
C601
R602 680 1/8W
FL601
FL602
FL603
T601
T602
T603
T604
C604 27
R603 47
C607 .033 UF
C606 .033UF
C609 .033 UF
U601
U602
R615 750
C605 .033UF
C602
R601 15K 1/8W
C603 .033UF
C608 .033UF
R604 510
C610 .001UF
C611 27
R616 5.1K
C615 27
C627 22UF
C613 .001UF
C612 22
C614 .033 UF
CR601
CR602
L602 10
C617 .033 UF
C618 .001UF
R617 1.5K
C616 .033UF
R606 1K
FM DET ADJUST
C620 3
C621 27
C619 .033UF
C622 .01UF
R608 25K
AUDIO LEVEL ADJUST
Q601
Q602
Q603
R611 8.2K
R612 390
C623 .22UF
C624 82
R609 43K
R610 150
C625 .01UF
R613 4.7K
R614 1.8K
C626 .001UF
L604 15
VOL SQ HI
R607 180K
FM DET METERING
1.2V
0.72V
5.1V
9.1V
0.1V
4.5V
9V
10V
1.45V
3.5V
3.8V
.35V
.14V
OSC - MULT
J602
COMPENSATION
F1
POS C MULT 1
POS D MULT 2
REG 10V
RX OSC CONTROL
A-
C629 .01UF
SAS
P903
J903
VOL SQ HI
BLKR DISABLE
J604
C630 20
R605 280K
J605
C628 .01UF
POS B IF AMP
POS A FM DET METERING
POS C MULT 1
POS D MULT 2
POS G 10V
POS F
J601
METERING
J601 (TOP VIEW)

ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF=MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH=MILLIHENRYS OR H=HENRYS.

VOLTAGE READING

VOLTAGE READINGS ARE TYPICAL READINGS MEASURED TO SYSTEM NEGATIVE (P903-6) WITH TEST SET MODEL 4EX3A11 OR A 20,000 OHM-PER-VOLT METER.

* COMPONENT VALUE TABLE			
IF FREQ	11.2 MHz	9.4 MHz	11.2 MHz
COMPONENT DESIGNATION	A	B	C
C601	.22 PF	.22 PF	.47 PF
C602	.56 PF	1.5 PF	
C604		27 PF	
C611		27 PF	
C615		27 PF	
C621		27 PF	
FL601	FL601A	FL601B	FL601C
FL602	FL602A	FL602B	
FL603	FL603A	FL603B	FL603C

IF DETECTOR	REV LETTER	IF FREQ	FREQ RANGE
19D432538G1		11.2 MHz	36-42 MHz, 66-88 MHz
19D432538 G2		9.4 MHz	30-36 MHz, 42-50 MHz 851-870 MHz
19D432538 G3		11.2 MHz	138-174 MHz, 406-512 MHz
19D432538 G4	–	11.2 MHz	36-42 MHz, 66-88 MHz
19D432538G5	–	9.4 MHz	30-36 MHz, 42-50 MHz 851-870 MHz
19D432538G6	–	11.2 MHz	138-174 MHz, 406-512 MHz

● 30-50 & 138-178 MHz NOISE BLANKER TEST POINT. 406-420 & 450-512 MHz MULT 3 TEST POINT.

■ PRESENT IN GROUPS 1, 2, 4 & 5

▲ PRESENT IN GROUPS 3 & 6

NOTES:

1. J623, J624 & P903 ARE PRESENT IN GROUPS 1, 2 & 3 ONLY FOR MASTR EXEC II
2. J606, J607 & J903 ARE PRESENT IN GROUPS 4, 5 & 6 ONLY FOR CUSTOM MVP

SCHEMATIC DIAGRAM

IF DETECTOR BOARD
19D432538G1-G6

(19D432536, Rev. 2)

- - -

m to

04.

m to

- - -

max.

max.

max.

- - -

m to

m to

- - - -

- - - -

)00 ohms

SYMBOL	GE PART NO.	DESCRIPTION
R609	19A143400P56	Deposited carbon: 43K ohms ±5%, 1/4 w.
R610	19A700019P27	Composition: 150 ohms ±5%, 1/4 w.
R611	19A700019P48	Composition: 8.2K ohms ±5%, 1/4 w.
R612	19A700019P32	Composition: 390 ohms ±5%, 1/4 w.
R613	19A700019P45	Composition: 4.7K ohms ±5%, 1/4 w.
R614	19A700019P40	Composition: 1.8K ohms ±5%, 1/4 w.
R615	19A143400P35	Deposited carbon: 750 ohms ±5%, 1/4 w.
R616	19A143400P45	Deposited carbon: 5.1K ohms ±5%, 1/4 w.
R617	19A700019P39	Composition: 1.5K ohms ±5%, 1/4 w.
		- - - - - - - - - - TRANSFORMERS - - - - - - - -
T601 thru T604	19A134747P2	Transformer, IF: resonant freq. 10.7 MHz; sim to TOKO Inc. 154 PC-470073N3.
		- - - - - - - - - TEST POINTS - - - - - - - - -
TP601	N503P304F15	Cotter pin.
		- - - - - - - INTEGRATED CIRCUITS - - - - - - -
U601 and U602	19A116445P1	Integrated circuit, linear: sim to ULN 2111.
		- - - - - - - - - MISCELLANEOUS - - - - - - - -
	19B226648G1	Shield. (Located around FL601, FL602).
	19B219571G1	Shield. (Located under L601, J624 on opposite side of component board).
	19B219554G1	Can. (Located around U602, Q603)
	19B219555P1	Cover. (Used with 19B219554G1 can).
	19B219727G1	Shield. (Located under 19B219554G1 can).
	19A116428P4	Ground tab; sim to AMP 86031-1 (Strip Form). (Used with shields on bottom of circuit board).

MOBILE RADIO

MASTR® *Executive II*
MAINTENANCE MANUAL
138-174 MHz, 300 MW TRANSMITTER KT-169-A

Maintenance Manual LBI30815

(DF3163, THIS SHEET ONLY)

138-174 MHz, MASTR Executive II TRANSMITTER

TABLE OF CONTENTS

SPECIFICATIONS ii

DESCRIPTION AND MAINTENANCE LBI30816 (DF3163)

EXCITER LBI30053 (DF3165)

RF OUTPUT MODULE LBI30817 (DF3166)

GENERAL ELECTRIC

PARTS LIST

IF DETECTOR BOARD
19D432538G1 11.2 MHz MASTR EXEC II
19D432538G2 9.4 MHz MASTR EXEC II
19D432538G3 11.2 MHz MASTR EXEC II
19D432538G4 11.2 MHz CUSTOM MVP
19D432538G5 9.4 MHz CUSTOM MVP
19D432538G6 11.2 MHz CUSTOM MVP
ISSUE 1

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C601A and C601B	19A700013P5	Phenolic: 0.22 pf ±5%, 500 VDCW.
C601C	19A700013P9	Phenolic: 0.47 pf ±5%, 500 VDCW.
C602A	19A700013P10	Phenolic: 0.56 pf ±5%, 500 VDCW.
C602B	19A700013P15	Phenolic: 1.50 pf ±5%, 500 VDCW.
C603	19A700234P10	Polyester: 0.033 µf ±10%, 50 VDCW.
C604	19A143491P27K8	Ceramic disc: 27 pf ±10%, 500 VDCW, temp coef -80 PPM.
C605 thru C609	19A700234P10	Polyester: 0.033 µf ±10%, 50 VDCW.
C610	19A143481P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C611	19A143491P27K8	Ceramic disc: 27 pf ±10%, 500 VDCW, temp coef -80 PPM.
C612	19A143491P22J4	Ceramic disc: 22 pf ±5%, 500 VDCW, temp coef -470 PPM.
C613	19A116192P13	Ceramic: 1000 pf ±10%, 50 VDCW; sim to Erie 8121-A050-W5R-102K.
C614	19A700234P10	Polyester: 0.033 µf ±10%, 50 VDCW.
C615	19A143491P27K8	Ceramic disc: 27 pf ±10%, 500 VDCW, temp coef -80 PPM.
C616 and C617	19A700234P10	Polyester: 0.033 µf ±10%, 50 VDCW.
C618	19A143481P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C619	19A700234P10	Polyester: 0.033 µf ±10%, 50 VDCW.
C620	19A143491P3J1	Ceramic disc: 3.0 pf ±0.5 pf, 500 VDCW, temp coef -150 PPM.
C621	19A143491P27K8	Ceramic disc: 27 pf ±10%, 500 VDCW, temp coef -80 PPM.
C622	19A700234P7	Polyester: 0.01 µf ±10%, 50 VDCW.
C623	19A116080P109	Polyester: 0.22 µf ±10%, 50 VDCW.
C624	19A700105P32	Mica: 82 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C625	19A700234P7	Polyester: 0.01 µf ±10%, 50 VDCW.
C626	19A143481P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C627	19A143486P9	Tantalum: 22 µf ±20%, 15 VDCW.
C628 and C629	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121 SPECIAL.
C630	19A116114P39	Ceramic: 20 pf ±5%, 100 VDCW; temp coef 0 PPM.
		- - - - - - - DIODES AND RECTIFIERS - - - - - -
CR601 and CR602	4038056P1	Germanium.
		- - - - - - - - - - - FILTERS - - - - - - - - -
FL601A	19B219573G3	Crystal, freq: Resonator A: 11,200000 KHz, Resonator B: 11,196024 KHz. Resonator A: 11,200000 KHz, Resonator B: 11,196024 KHz.
FL601B	19B219574G3	Crystal freq: Resonator A: 9400.300 KHz, Resonator B: 9396.324 KHz. Resonator A: 9400.300 KHz, Resonator B: 9396.324 KHz.
FL601C*	19B219573G6	Crystal freq: Resonator A: 11,200000 KHz, Resonator B: 11,200000 KHz.
		In G1 of REV B and earlier: In G3 of REV D and earlier:
	19B219573G1	Crystal freq: Resonator A: 11,200000 KHz, Resonator B: 11,200000 KHz.
FL602A		(Part of FL601A).
FL602B		(Part of FL601B).
FL603A	19B219573G6	Crystal freq: Resonator A: 11,200000 KHz, Resonator B: 11,200000 KHz.
FL603B	19B219574G1	Crystal freq: Resonator A: 9400.300 KHz, Resonator B: 9400.300 KHz.
FL603C	19B219573G6	Crystal freq: Resonator A: 11,200000 KHz, Resonator B: 11,200000 KHz.
		- - - - - - - JACKS AND RECEPTACLES - - - - - -
J601	19B219374G1	Connector. Includes:
	19C317957P1	Shell.
	19A116651P1	Contact, electrical; sim to Malco X0-2864.
J602	19A116659P106	Connector, printed wiring: 7 contacts; sim to Molex 09-60-1071.
J604 thru J607	19A116779P1	Contact, electrical; sim to Molex 08-50-0404.
J623 and J624	19A116975P1	Contact, electrical.
J903	19A116659P106	Connector, printed wiring: 7 contacts; sim to Molex 09-60-1071.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L601	19A700000P25	Choke, RF: 15.0 µh ±10%, 1.20 ohms DC res max.
L602	19A700024P25	Coil, RF: 10.0 µh ±10%, 3.70 ohms DC res max.
L604	19A700000P25	Choke, RF: 15.0 µh ±10%, 1.20 ohms DC res max.
		- - - - - - - - - - - PLUGS - - - - - - - - - -
P903		Connector. Includes:
	19A116659P1	Connector, printed wiring: 3 contacts; sim to Molex 09-52-3032.
	19A116659P15	Connector, printed wiring: 4 contacts; sim to Molex 09-52-3042.
		- - - - - - - - - - TRANSISTORS - - - - - - - - -
Q601 thru Q603	19A115910P1	Silicon, NPN; sim to Type 2N3904.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R601	3R151P153J	Composition: 15K ohms ±5%, 1/8 w.
R602	3R151P681J	Composition: 680 ohms ±5%, 1/8 w.
R603	19A700019P21	Composition: 47 ohms ±5%, 1/4 w.
R604	19A143400P33	Composition: 510 ohms ±5%, 1/4 w.
R605	19C314256P22803	Metal film: 280K ohms ±1%, 1/4 w.
R606	19A700019P37	Composition: 1K ohms ±10%, 1/4 w.
R607	19A700019P64	Composition: 0.18 megohm ±5%, 1/4 w.
R608	19B209358P107	Variable, carbon film: approx 800 to 25,000 ohms ±10%, 0.25 w; sim to CTS Type X-201.
R609	19A143400P56	Deposited carbon: 43K ohms ±5%, 1/4 w.
R610	19A700019P27	Composition: 150 ohms ±5%, 1/4 w.
R611	19A700019P48	Composition: 8.2K ohms ±5%, 1/4 w.
R612	19A700019P32	Composition: 390 ohms ±5%, 1/4 w.
R613	19A700019P45	Composition: 4.7K ohms ±5%, 1/4 w.
R614	19A700019P40	Composition: 1.8K ohms ±5%, 1/4 w.
R615	19A143400P35	Deposited carbon: 750 ohms ±5%, 1/4 w.
R616	19A143400P45	Deposited carbon: 5.1K ohms ±5%, 1/4 w.
R617	19A700019P39	Composition: 1.5K ohms ±5%, 1/4 w.
		- - - - - - - - - - - TRANSFORMERS - - - - - - - -
T601 thru T604	19A134747P2	Transformer, IF: resonant freq. 10.7 MHz; sim to TOKO Inc. 154 PC-470073N3.
		- - - - - - - - - - TEST POINTS - - - - - - - - -
TP601	N503P304F15	Cotter pin.
		- - - - - - - INTEGRATED CIRCUITS - - - - - - -
U601 and U602	19A116445P1	Integrated circuit, linear: sim to ULN 2111.
		- - - - - - - - - - MISCELLANEOUS - - - - - - - -
	19B226648G1	Shield. (Located around FL601, FL602).
	19B219571G1	Shield. (Located under L601, J624 on opposite side of component board).
	19B219554G1	Can. (Located around U602, Q603)
	19B219555P1	Cover. (Used with 19B219554G1 can).
	19B219727G1	Shield. (Located under 19B219554G1 can).
	19A116428P4	Ground tab; sim to AMP 86031-1 (Strip Form). (Used with shields on bottom of circuit board).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

MOBILE RADIO

MASTR® Executive II MAINTENANCE MANUAL

138-174 MHz, 300 MW TRANSMITTER KT-169-A

Maintenance Manual LBI30815

(DF3163, THIS SHEET ONLY)

138-174 MHz, MASTR Executive II TRANSMITTER

TABLE OF CONTENTS

SPECIFICATIONS ii

DESCRIPTION AND MAINTENANCE LBI30816 (DF3163)

EXCITER LBI30053 (DF3165)

RF OUTPUT MODULE LBI30817 (DF3166)

GENERAL ELECTRIC

of transmitted RF power. The transmitter consists of:

Exciter Board; with audio, modulator, amplifier and multiplier stages.

Power Amplifier/Antenna Switch Assembly; with PA final, solid state antenna switch and low pass filter assembly.

Figure 1 is a block diagram of the transmitter showing the exciter and power amplifier/antenna switch assembly.

The exciter contains the oscillator, audio IC, modulator and multipliers to provide 250 milliwatts of modulated RF power to the power amplifier.

The power amplifier/antenna switch assembly includes a single transistor stage to provide rated output power, a solid state switch to switch the antenna between the transmitter and receiver and a low pass filter with a 20 dB pad for connecting the antenna to the optional monitor receiver.

MAINTENANCE

DISASSEMBLY

To service the transmitter, remove the two retaining screws from the front cap assembly and pull radio out of case assembly.

To remove Exciter Board:

1. Unplug cable W216 (exciter output).
2. Remove the six screws holding the Exciter Board to the mounting frame and gently lift Exciter Board out of radio.

To remove the PA Board:

NOTE

The PA heat sink assembly pivots 90° to permit access to the PA board.

1. Remove screws holding hinged PA heat sink to swing down PA heat sink.
2. Remove PA top cover and unplug the exciter/PA cable W216; unsolder the PA/low pass filter cable W214 from H9 and shield from ground.
3. Unplug receiver/PA cable W217; Unplug power cable W215 from System Board.
4. Remove screws and cable clamps on W215, W216 and W217.
5. Remove the four PA Board mounting screws and lift the board out.

PA TRANSISTOR REPLACEMENT:

1. Turn the PA Board over.
2. Unsolder one lead at a time with a 25 watt soldering iron. Use a scribe to hold the lead away from the printed circuit board until the solder cools.
3. Lift out the transistor and remove the old solder from the printed circuit board with a de-soldering tool such as a SOLDA-PULLT®. Special care should be taken to prevent damage to the printed circuit board runs.
4. Trim the new transistor leads (if required) to the lead length of the removed transistor.
5. Apply a coat of silicon grease around the transistor body and slide heat sink over transistor body. Align the leads as shown on the Outline Diagram.
6. Make sure that the transistor leads are formed so that the leads can be soldered to the printed circuit pattern, starting from the inner edge of the mounting hole.
7. Solder the leads to the printed circuit pattern. Start at the inner edge of mounting hole and solder the remaining length of transistor lead to the board. Use care not to use excessive heat that causes the printed circuit board runs to lift up from the board. Check for shorts and solder bridges before applying power.

CAUTION

Failure to solder the transistor leads as directed may result in the generation of RF loops that could damage the transistor or may cause low power output.

TROUBLESHOOTING

A Troubleshooting Procedure, including QUICK CHECKS, permits rapid fault location in the exciter and power amplifier.

GENERAL ELECTRIC COMPANY • MOBILE COMMUNICATIONS DIVISION
WORLD HEADQUARTERS • LYNCHBURG, VIRGINIA 24502 U.S.A.

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U.S.A.

* Trademark of General Electric Company U.S.A.
Printed in U.S.A

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TROL	METE
T101	See
	See
T103	See
T105	See
	Maxim
	Maxim
	Maxim
	Maxim

OSCILLATOR FREQUENCY ADJUSTMENT

First, check the frequency to determine if any adjustment is required. The frequency should be set using a frequency meter or counter with an absolute accuracy that is 5 to 10 times better than the tolerance to be maintained, and with the entire radio as near as possible to an ambient temperature of 30°C (86°F).

The oscillator should be reset only when the frequency shows deviation in excess of the following limits:

A. ±0.6 PPM, when the radio is at 30°C (86°F).

B. ±5 PPM at any other temperature within the range of -30°C to +75°C (-22°F to +167°F).

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If the radio is not at an ambient temperature of 30°C, setting errors can be minimized as follows:

A. To hold the setting error to ±0.6 PPM (which is considered reasonable for 5 PPM crystal oscillators):

1. Maintain the radio at 30°C and set the oscillator to desired frequency, or

2. Maintain the radio at 30°C (+5°C, -15°C) offset the operating frequency as a function of actual temperature, by the amount shown in Figure 2.

For example: Assume the ambient temperature of the radio is 20°C (68°F). At that temperature, the curve shows a correction factor of 225 Hz.

Set C3 on the selected crystal module for a reading of 225 Hz higher than the licensed operating frequency. If a negative correction factor is obtained (at temperatures above 30°C), set the oscillator for the indicated frequency lower than the licensed operating frequency.

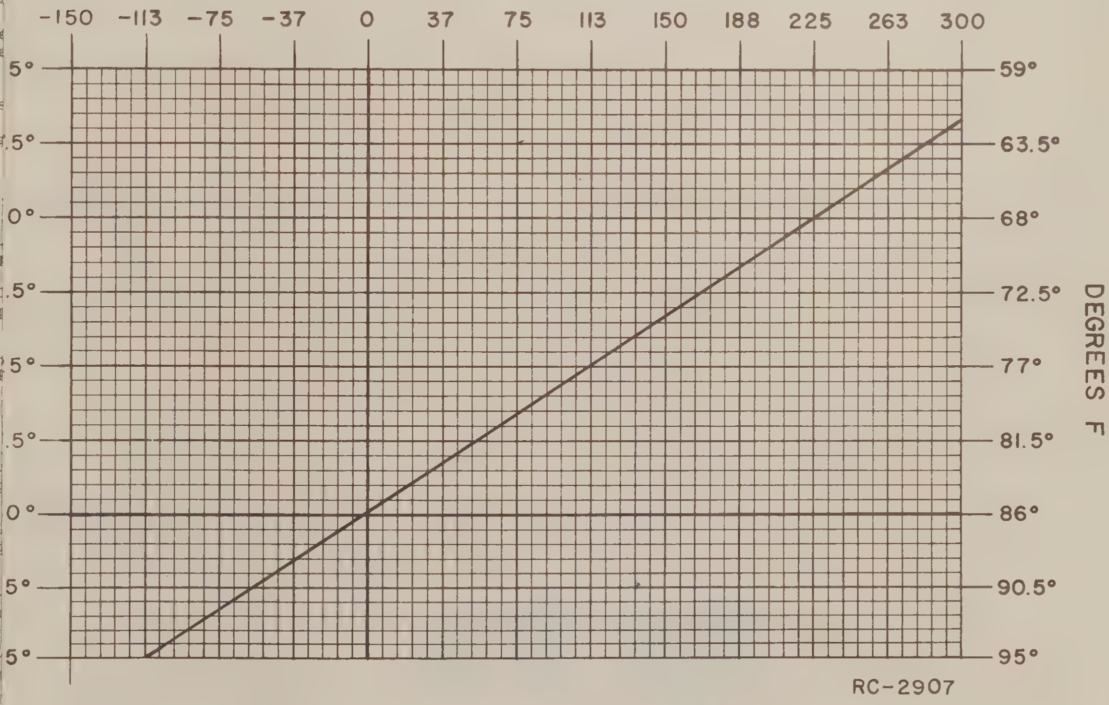

Figure 2 - Frequency Characteristics Vs. Temperature

ALIGNMENT PROCEDURE

138—174 MHz, 300 MW TRANSMITTER

of transmitted RF power. The transmitter consists of:

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4. Trim the new transistor leads (if required) to the lead length of the removed transistor.
5. Apply a coat of silicon grease around the transistor body and slide heat sink over transistor body. Align the leads as shown on the Outline Diagram.
6. Make sure that the transistor leads are formed so that the leads can be soldered to the printed circuit pattern, starting from the inner edge of the mounting hole.
7. Solder the leads to the printed circuit pattern. Start at the inner edge of mounting hole and solder the remaining length of transistor lead to the board. Use care not to use excessive heat that causes the printed circuit board runs to lift up from the board. Check for shorts and solder bridges before applying power.

CAUTION

Failure to solder the transistor leads as directed may result in the generation of RF loops that could damage the transistor or may cause low power output.

TROUBLESHOOTING

A Troubleshooting Procedure, including QUICK CHECKS, permits rapid fault location in the exciter and power amplifier.

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CAUTION

Before bench testing the radio, be sure of the output voltage characteristics of your bench power supply.

To protect the transmitter power output transistors from possible instant destruction, the following input voltages must not be exceeded:

Transmitter unkeyed: 20 Volts
Transmitter keyed (50 ohm resistive load) 18 Volts
Transmitter keyed (no load or non-resistive load): 15.5 Volts

These voltages are specified at the normal vehicle battery terminals of the radio and take the voltage drop of standard cables into account. The voltage limits shown for a non-optimum load is for "worst case" conditions. For antenna mismatches likely to be encountered in practice, the actual limit will approach the 18 Volt figure.

Routine transmitter tests should be performed at EIA Standard Test Voltages (13.8 VDC for loads of 0 to 6 amperes: Input voltages must not exceed the limits shown, even for transient peaks of short duration.

TEST EQUIPMENT

1. An audio oscillator
2. A deviation monitor
3. A Multimeter and AC voltmeter
4. GE Test Set Models 4EX3A11 or 4EX8K12
5. Wattmeter, 50 ohm connected to antenna jack J2 (1 watt element recommended)
6. Frequency Counter

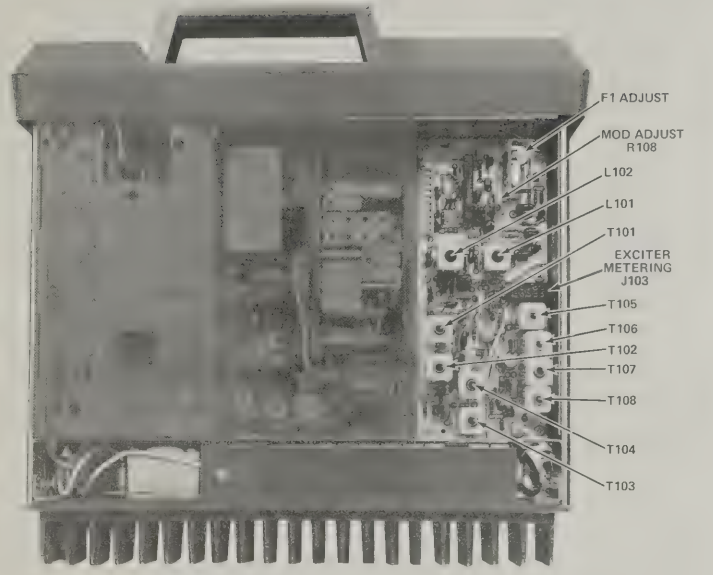
TRANSMITTER ALIGNMENT

PRELIMINARY CHECKS AND ADJUSTMENTS

1. Place crystal module for F1 on Exciter Board (crystal frequency - operating frequency ÷ 12).
2. For a large change in frequency or a badly mis-aligned transmitter, preset all slugs to the top of the coil forms.
3. Connect the black plug to the Exciter Board metering jack. Set the polarity to + and set the range to the Test 1 position (1-Volt position for 4EX8K12) for all adjustments.
4. All adjustments are made with the transmitter keyed. The transmitter is keyed by applying a ground to test point TP17 on the System Board. Unkey the transmitter between steps to avoid unnecessary heating.
5. Set tuning slugs in L101, L102 and T101 through T108 to top of coil forms.

ALIGNMENT PROCEDURE

STEP	METER POSITION	TUNING CONTROL	METER READING	PROCEDURE
1.	A (MULT-1)	L101, L102 & T101	See Procedure	Tune L101 then L102 for maximum meter reading on highest frequency. Then with lowest frequency selected, tune T101 for a dip in meter reading.
2.	A	L102	See Procedure	Using a deviation monitor, check the symmetry of the modulator at 300 Hz using the highest and lowest assigned operating frequencies. If more than 0.5 dissymmetry exists, tune L102 to optimize symmetry. NOTE: L102 should not be adjusted more than ±1/8 turn from previous setting. If a deviation monitor is not available, adjust L102 1/8 turn counterclockwise.
3.	B (MULT-2)	T102, T101 & T103	See Procedure	Tune T102 for maximum meter reading and re-adjust T101 for maximum meter reading. Then tune T103 for a dip in meter reading.
4.	C (MULT-3)	T104, T103 & T105	See Procedure	Tune T104 for maximum meter reading and re-adjust T103 for maximum meter reading. Then tune T105 for a dip in meter reading.
5.	F (AMPL-1)	T106 & T105	Maximum	Tune T106 for maximum meter reading, and then re-adjust T105 for maximum meter reading.
6.	G (Rel. Power Out)	T107 & T108	Maximum	Tune T107 and then T108 for maximum meter reading. Then, alternately re-tune T107 & T108 for maximum meter reading.
7.	F (AMPL-1 DRIVE)	T105 & T106	Maximum	Re-adjust T105 and T106 for maximum meter reading.
8.		T105, T106, T107 & T108	Maximum	Re-adjust for maximum reading on the wattmeter connected to antenna jack.



MODULATION LEVEL ADJUSTMENT

MOD ADJUST control R108 has been adjusted to the proper setting before shipment and should not normally require readjustment.

PROCEDURE

1. Connect the audio oscillator and the AC meter across audio input terminals J10 (Green-Hi) and J11 (Black-Lo) on GE Test Set and connect the black plug to the Exciter Board metering jack. If not using GE Test Set, connect audio oscillator and meter across P902-4 (Mic Hi) through a 0.5 microfarad (or larger) DC blocking capacitor and P902-5 (Mic Lo) on the Exciter Board.
2. Adjust the audio oscillator for 1 Volt RMS at 1000 Hz. Adjust R3 on Vehicular Repeater System board to maximum clockwise position.
3. Key transmitter by placing a ground on test point TP17 on the System Board.

DEVIATION ADJUSTMENT

1. Set MOD ADJUST control R108 for a 4.75 kHz swing with the deviation polarity which gives the highest reading as indicated on the frequency modulation monitor.

NOTE

If the deviation reading plus (+) or minus (-) differs more than 0.5 kHz, recheck Step 1 as shown in the Transmitter Alignment Chart.

2. Reduce level of R3 to obtain 3 kHz deviation.

OSCILLATOR FREQUENCY ADJUSTMENT

First, check the frequency to determine if any adjustment is required. The frequency should be set using a frequency meter or counter with an absolute accuracy that is 5 to 10 times better than the tolerance to be maintained, and with the entire radio as near as possible to an ambient temperature of 30°C (86°F).

The oscillator should be reset only when the frequency shows deviation in excess of the following limits:

A. ±0.6 PPM, when the radio is at 30°C (86°F)

B. ±5 PPM at any other temperature within the range of -30°C to +75°C (-22°F to +167°F).

If an adjustment is required, proceed as [illegible]

If the radio is at an ambient temperature of 30°C (86°F), set the oscillator for the correct operation frequency.

If the radio is not at an ambient temperature of 30°C, setting errors can be minimized as follows:

A. To hold the setting error to ±0.6 PPM (which is considered reasonable for 5 PPM crystal oscillators):

1. Maintain the radio at 30°C and set the oscillator to desired frequency, or
2. Maintain the radio at 30°C (+5°C, -15°C) offset the operating frequency as a function of actual temperature, by the amount shown in Fig [illegible]

For example: Assume the ambient temperature of [illegible] temperature, the curve shows a correction [illegible]

Set C3 on the selected crystal module for a reading of 225 Hz higher than the licensed operating frequency. If a negative correction factor is obtained (at temperatures above 30°C), set the oscillator for the indicated frequency lower than the licensed operating frequency.

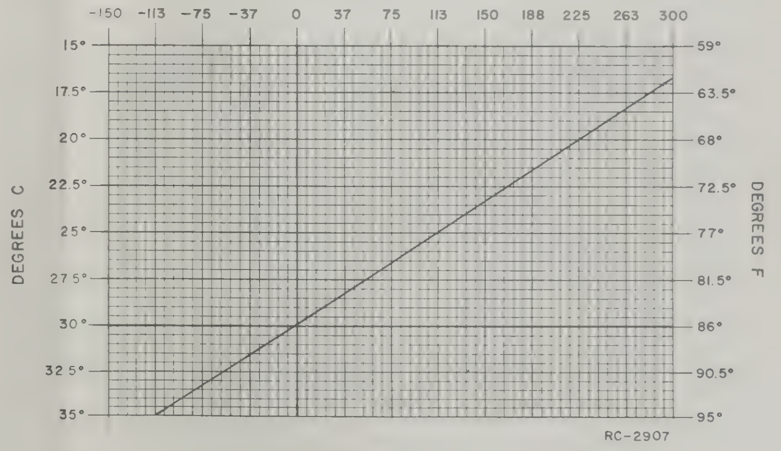
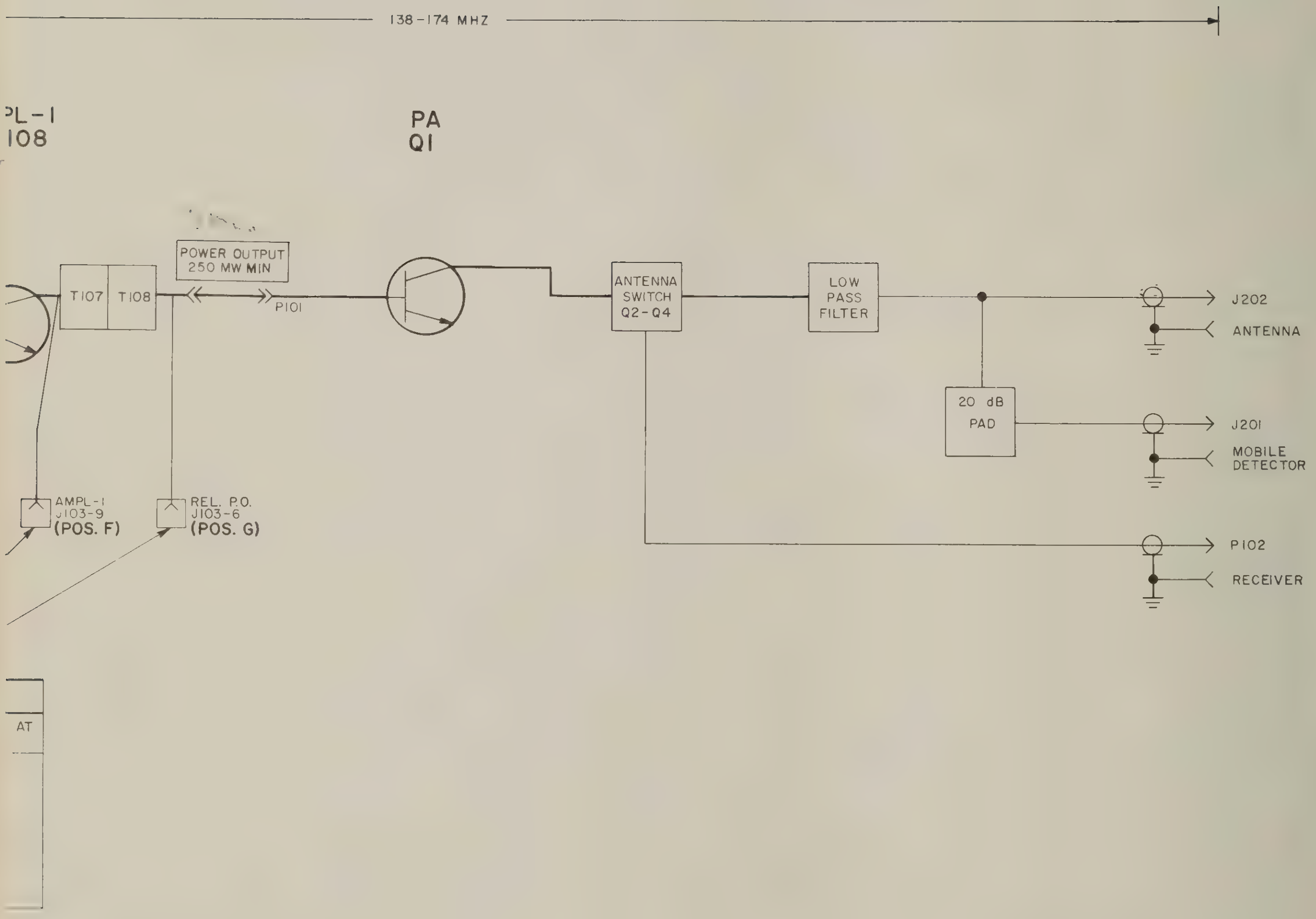


Figure 2 - Frequency Characteristics Vs. Temperature


138-174 MHZ
PL-1
108
PA
Q1
POWER OUTPUT
250 MW MIN
T107
T108
P101
ANTENNA
SWITCH
Q2-Q4
LOW
PASS
FILTER
20 dB
PAD
J202
ANTENNA
J201
MOBILE
DETECTOR
P102
RECEIVER
AMPL-1
J103-9
(POS. F)
REL. P.O.
J103-6
(POS. G)
AT

RC3867

LBI30053F
(DF3165)
(DF3170
IMTS)

MAINTENANCE MANUAL
138-174 MHz EXCITER BOARD 19D423293G1, G2

TABLE OF CONTENTS

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DESCRIPTION	1
CIRCUIT ANALYSIS	1
OUTLINE DIAGRAM	4
SCHEMATIC DIAGRAM	5
PARTS LIST AND PRODUCTION CHANGES	6

DESCRIPTION

The exciter uses seven transistors, a crystal module and an integrated circuit to provide 250 milliwatt of power to drive the PA assembly. The crystal module determines the (F1) transmitting frequency in single frequency applications.

In multi-frequency transmitters, the crystal modules for frequencies F2-F4 are located on the multi-frequency board.

The crystal frequency ranges from approximately 11.5 to 14.5 megahertz, and is multiplied 12 times.

Audio, supply voltages and control functions are connected from the system audio and squelch board to the exciter board through P902.

Centralized metering jack J103 is provided for use with GE Test Set Model 4EX3A11 or Test Kit 4EX8K12. The Test Set meters the multipliers, amplifier and the regulated 10 Volt supply.

CIRCUIT ANALYSIS

F1 OSCILLATOR CIRCUIT

A Colpitts oscillator comprised of Q102, a plug-in crystal module and associated components provides the fundamental operating frequency for the transmitter. The crystal module in the collector base circuit of Q102 is temperature compensated to maintain frequency stability within ±5 PPM over a temperature range of -30°C to +65°C. Compensation voltage is applied from compensator circuit Q101. The output of the oscillator is taken from the collector of Q102, buffered by Q103 and applied to modulator CR101 and CR102.

With the radio turned on and the PTT switch operated, +10 Volts is present on the Tx OSC lead at P902-1 and the emitter of oscillator Q102. R104 and R105 comprise a voltage divider network to establish the bias voltage for Q102, allowing it to oscillate at the crystal frequency.

SERVICE NOTE

Y1 and C2 are not field replaceable items. C2 is factory selected to compliment the temperature/frequency characteristics of each individual crystal. Should it become necessary to replace either Y1 or C2, the entire crystal module must be replaced.

In single frequency radios, the F1 keying lead is connected directly to A- by a DA jumper connected between H12 and H31 on the system, audio, squelch board (SAS). This assures F1 oscillator operation each time the PTT switch is pressed.

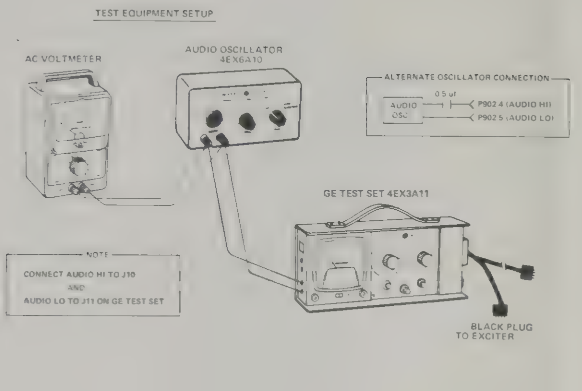
With the radio turned on and the PTT switch operated, +10 Volts is present on the transmitter oscillator lead at P902-1 and the emitter of Q102. R104 and R105 comprise a voltage divider network to establish the base voltage for Q102 allowing it to oscillate at the crystal frequency to allow E1 frequency selection via the frequency selector switch on the control unit.

When frequencies F2 thru F4 are selected the oscillator output frequency from the multi-frequency board is supplied to buffer Q103 through J102-1 on the exciter and cable W2601.

COMPENSATOR CIRCUITS

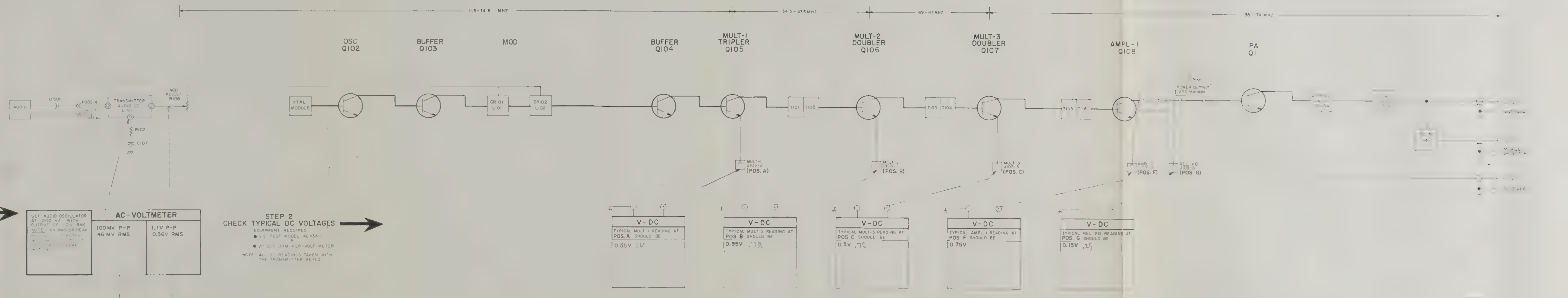
The crystal modules are temperature compensated at both ends of the temperature range to provide instant frequency compensation. The temperature compensator consists of Q101, VR101, RT101, RT102 and associated components. Zener diode VR101 provides a constant +8.5 V reference voltage for compensator Q101.

The cold end compensation circuit does not operate at temperatures above -10°C (+14°F). When the temperature drops below -10°C, the circuit is activated. As the temperature increases, the resistance of


TEST EQUIPMENT SETUP
AC VOLTMETER
AUDIO OSCILLATOR 4EX6A10
ALTERNATE OSCILLATOR CONNECTION
AUDIO OSC
0.5 uf
P902-4 (AUDIO HI)
P902-5 (AUDIO LO)
GE TEST SET 4EX3A11
BLACK PLUG TO EXCITER

NOTE

CONNECT AUDIO HI TO J10
AND
AUDIO LO TO J11 ON GE TEST SET


11.5-14.5 MHZ
34.5-43.5 MHZ
69-87 MHZ
138-174 MHZ
AUDIO
0.5UF
P902-4
TRANSMITTER AUDIO IC U101
12
2
9
R102
C107
MOD ADJUST R108
OSC Q102
BUFFER Q103
MOD
XTAL MODULE
CR101 L101
CR102 L102
BUFFER Q104
MULT-1 TRIPLER Q105
T101
T102
MULT-2 DOUBLER Q106
T103
T104
MULT-3 DOUBLER Q107
T105
T106
AMPL-1 Q108
PA Q1
POWER OUTPUT 250 MW MIN
MULT-1 J103-2 (POS. A)
(POS. B)
MULT-3 J103-3 (POS. C)
AMPL (POS. F)
REL. PO J103-6 (POS. G)
V-DC

TYPICAL MULT-1 READING AT POS. A SHOULD BE 0.55V 1V

TYPICAL MULT-2 READING AT POS B SHOULD BE 0.85V .75

TYPICAL MULT-3 READING AT POS C SHOULD BE 0.5V .70

TYPICAL AMPL-1 READING AT POS F SHOULD BE 0.75V

TYPICAL REL PO READING AT POS. G SHOULD BE 0.15V .25

STEP 2
CHECK TYPICAL DC VOLTAGES

EQUIPMENT REQUIRED
- G.E. TEST MODEL 4EX3A11
OR
- 20,000 OHM-PER-VOLT METER

NOTE: ALL DC READINGS TAKEN WITH THE TRANSMITTER KEYED

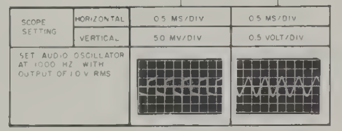
STEP 3
CHECK AUDIO AC VOLTAGES

EQUIPMENT REQUIRED
- AUDIO OSCILLATOR
- AC VOLTMETER

	AC-VOLTMETER	
SET AUDIO OSCILLATOR AT 1000 HZ WITH OUTPUT OF 1.0 V RMS NOTE: AN RMS OR PEAK [illegible]	100MV P-P 46 MV RMS	1.1V P-P 0.36V RMS

STEP 4
AUDIO & OSC WAVEFORMS

EQUIPMENT REQUIRED
- AUDIO OSCILLATOR
- OSSILLOSCOPE



SCOPE SETTING	HORIZONTAL	0.5 MS/DIV	0.5 MS/DIV
	VERTICAL	50 MV/DIV	0.5 VOLT/DIV
SET AUDIO OSCILLATOR AT 1000 HZ WITH OUTPUT OF 1.0 V RMS			

STEP 5
AUDIO SENSITIVITY

CHECK AUDIO SENSITIVITY BY REDUCING GENERATOR OUTPUT UNTIL DEVIATION FALLS TO 3.0K Hz VOLTAGE SHOULD BE LESS THAN 120 MILLIVOLT

STEP 1 - QUICK CHECKS

METER POSITION GE TEST SET	PROBABLE DEFECTIVE STAGE		
	HIGH METER READING	LOW METER READING	ZERO METER READING
EXCITER			
A (MULT-1)	Q104, Q105 T101	Q104, Q105	Q104, Q105 T101
B (MULT-2)	Q106, T103	Q106, T101 T102	T101, T102, Q106, T103
C (MULT-3)	Q107, T105	T103, T104 Q107	T103, T104, Q107, T105
F (AMPL-1)	Q108, C149	T105, T106, Q108	T105, T106, Q108, L108

TROUBLESHOOTING PROCEDURE

138—174 MHz, 300 MW TRANSMITTER

MAINTENANCE MANUAL
138-174 MHz EXCITER BOARD 19D423293G1, G2

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DESCRIPTION

The exciter uses seven transistors, a crystal module and an integrated circuit to provide 250 milliwatt of power to drive the PA assembly. The crystal module determines the (F1) transmitting frequency in single frequency applications.

In multi-frequency transmitters, the crystal modules for frequencies F2-F4 are located on the multi-frequency board.

The crystal frequency ranges from approximately 11.5 to 14.5 megahertz, and is multiplied 12 times.

Audio, supply voltages and control functions are connected from the system audio and squelch board to the exciter board through P902.

Centralized metering jack J103 is provided for use with GE Test Set Model 4EX3A11 or Test Kit 4EX8K12. The Test Set meters the multipliers, amplifier and the regulated 10 Volt supply.

CIRCUIT ANALYSIS

F1 OSCILLATOR CIRCUIT

A Colpitts oscillator comprised of Q102, a plug-in crystal module and associated components provides the fundamental operating frequency for the transmitter. The crystal module in the collector base circuit of Q102 is temperature compensated to maintain frequency stability within ±5 PPM over a temperature range of -30°C to +65°C. Compensation voltage is applied from compensator circuit Q101. The output of the oscillator is taken from the collector of Q102, buffered by Q103 and applied to modulator CR101 and CR102.

With the radio turned on and the PTT switch operated, +10 Volts is present on the Tx OSC lead at P902-1 and the emitter of oscillator Q102. R104 and R105 comprise a voltage divider network to establish the bias voltage for Q102, allowing it to oscillate at the crystal frequency.

SERVICE NOTE

Y1 and C2 are not field replaceable items. C2 is factory selected to compliment the temperature/frequency characteristics of each individual crystal. Should it become necessary to replace either Y1 or C2, the entire crystal module must be replaced.

In single frequency radios, the F1 keying lead is connected directly to A- by a DA jumper connected between H12 and H31 on the system, audio, squelch board (SAS). This assures F1 oscillator operation each time the PTT switch is pressed.

With the radio turned on and the PTT switch operated, +10 Volts is present on the transmitter oscillator lead at P902-1 and the emitter of Q102. R104 and R105 comprise a voltage divider network to establish the base voltage for Q102 allowing it to oscillate at the crystal frequency to allow E1 frequency selection via the frequency selector switch on the control unit.

When frequencies F2 thru F4 are selected the oscillator output frequency from the multi-frequency board is supplied to buffer Q103 through J102-1 on the exciter and cable W2601.

COMPENSATOR CIRCUITS

The crystal modules are temperature compensated at both ends of the temperature range to provide instant frequency compensation. The temperature compensator consists of Q101, VR101, RT101, RT102 and associated components. Zener diode VR101 provides a constant +8.5 V reference voltage for compensator Q101.

The cold end compensation circuit does not operate at temperatures above -10°C (+14°F). When the temperature drops below -10°C, the circuit is activated. As the temperature increases, the resistance of

RT101 increases and the compensation voltage increases.

An increase in compensation voltage decreases the capacitance of the varactor in the oscillator, thereby increasing the output frequency of the crystal module.

The hot end compensation circuit does not operate at temperatures below +55°C (131°F). When the temperature rises above +55°C, the circuit is activated. As the temperature increases, the resistance of RT102 decreases and the compensation voltage decreases. The decrease in compensation voltage increases the capacity of the varactor, decreasing the output frequency of the crystal module.

Listed below are typical minimum and maximum voltage readings to be expected at pin 4 of the crystal modules. Voltages should be measured using a high impedance meter.

TEMPERATURE RANGE	OUTPUT	VOLTAGE
	MINIMUM	MAXIMUM
-30°	4.9 Volts	6.0 Volts
-10° to 50°C	3.7 Volts	4.3 Volts
+75°C	3.3 Volts	3.8 Volts

AUDIO IC

The transmitter audio circuitry is contained in audio IC U101. A simplified drawing of the audio IC is shown in Figure 1.

Audio from the microphone at pin 12 is coupled through pre-emphasis capacitor C1 to the base of Q1 in the operational amplifier-limiter circuit. Collector voltage for the transistorized microphone preamplifier is supplied from the 10 Volt regulator through R979 and R980 on the System-Audio-Squelch board to J901A-14 in MASTR®.

EXECUTIVE II RADIOS

In Custom MVP radios, collector voltage for the transistorized microphone preamplifier is supplied from the 20 Volt regulator on the SAS board through R28, R29 and J913 to the microphone.

The operational amplifier-limiter circuit consists of Q1, Q2 and Q3. Q3 provides limiting at high signal levels. The gain of the operational amplifier circuit is fixed by negative feedback through R19, R20 and the resistance in the network (Pin 9).

The output of Q3 is coupled through a de-emphasis network (R10 and C3) to an active post-limiter filter consisting of C4, C5, C6, R11, R12, R13, R15, R17 and Q4.

Following the post-limiter filter is class A amplifier Q5. The output of Q5 is coupled through MOD ADJUST potentiometer R108 and resistors R109 and R115 to the phase modulators.

SERVICE NOTE: If the DC voltages applied to the audio IC are correct and there is no audio output, replace U101.

For radios equipped with Channel Guard, tone from the encoder is applied to the phase modulators through P902-9, (CG HI) and resistors R112 and R117. Instructions for setting Channel Guard modulation are located in the Transmitter Alignment Procedures.

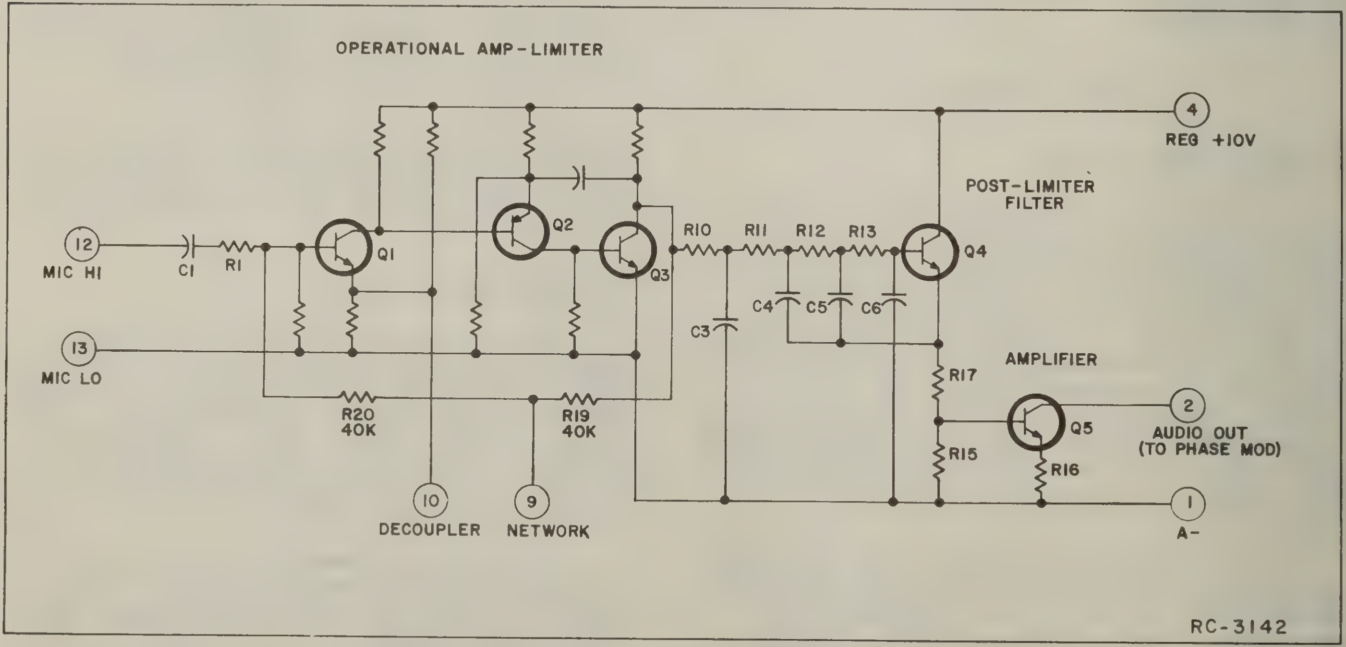

Figure 1 - Simplified Audio IC

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BUFFER & PHASE MODULATOR

The oscillator output is coupled through buffer-amplifier Q103 to the modulator. The first phase modulator is varactor (voltage-variable capacitor) CR101 is connected in series with tunable coil L101.

This network appears as a series-resonant circuit to the RF output of the oscillator. An audio signal applied to the modulator circuit through blocking capacitor C114 varies the bias of CR101, resulting in a phase modulated output. A voltage divider network (R109 and R113) provides the proper bias for varactors CR101 and CR102.

The output of the modulator is coupled through blocking capacitor C119 to the base of buffer Q104.

MULTIPLIERS & AMPLIFIER

Buffer Q104 is saturated when no RF signal is present. Applying an RF signal to Q104 provides a sawtooth waveform at its collector to drive class C tripler, Q105. The tripler stage is metered through R122. The output of Q105 is coupled through tuned circuits T101 and T102 to the base of doubler Q106. T101 and T102 are tuned to one-fourth of the operating frequency. The doubler stage is metered through R124.

The output of Q106 is coupled through tuned circuits T103 and T104 to the base of second doubler Q107. T103 and T104 are tuned to one-half the operating frequency. Q107 is metered through R129.

The output of Q107 is coupled through two tuned circuits (T105 and T106) to the base of amplifier Q109. These circuits are tuned to the transmitter operating frequency.

Q108 is a class C amplifier, and is metered through R130. The amplifier collector circuit consists of T107, C146, C147, T108 and C149, and matches the amplifier output to the input of the power amplifier assembly.

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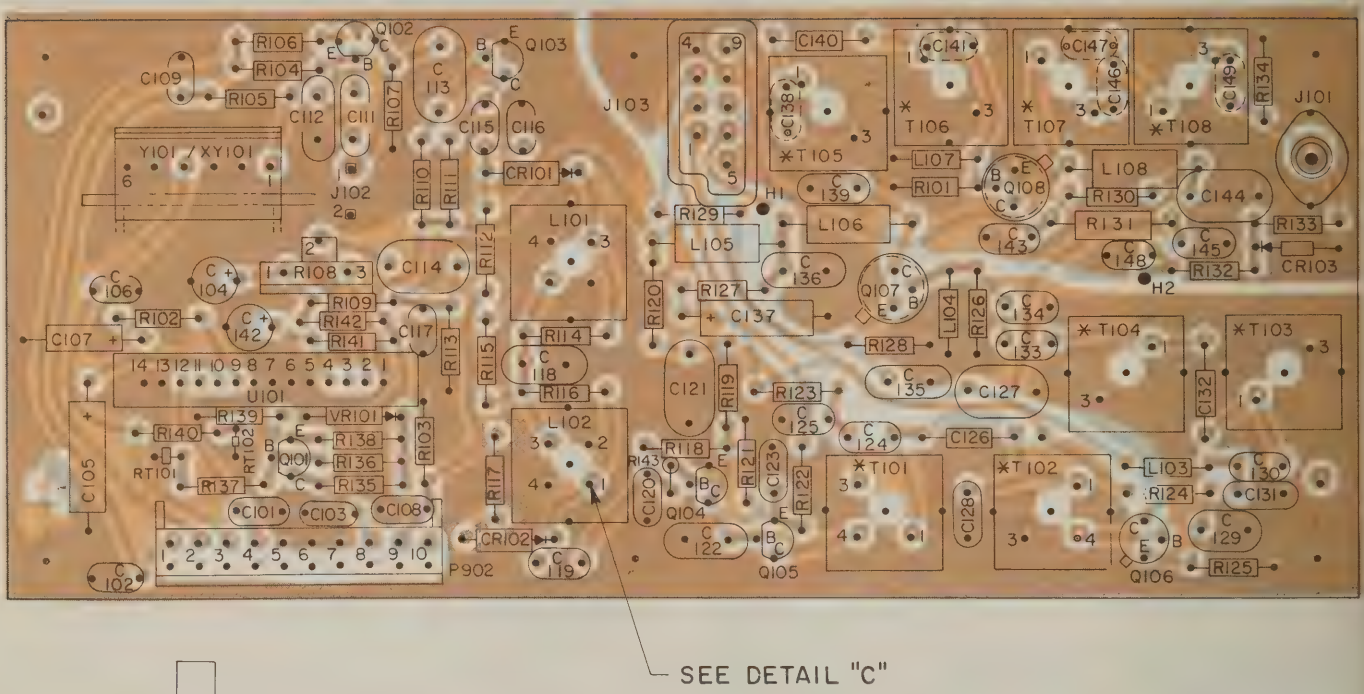
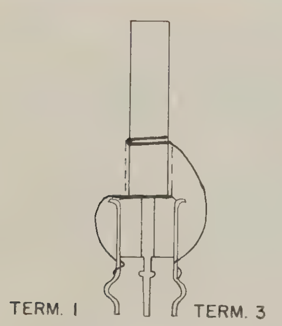

R106
R104
R105
C109
Q102
Q103
C112
C111
R107
C113
C115
C116
J103
J102
Y101 / XY101
CR101
R110
R111
L101
R112
C114
R108
C106
C104
R102
C107
C142
R109
R142
R141
C117
R113
R115
R114
C118
R116
U101
C105
R140
RT101
RT102
Q101
R139
VR101
R138
R136
R137
R135
R103
L102
R117
C101
C103
C108
P902
C102
CR102
C119
R143
C120
Q104
R118
R119
C121
R120
R127
C137
R129
L105
H1
C136
C140
C138
T105
C139
R101
L107
T106
C141
T107
C147
C146
T108
C149
R134
J101
Q108
L108
R130
C144
R131
R133
L106
C143
C148
C145
R132
CR103
H2
Q107
L104
R126
C134
C133
R128
T104
T103
C135
C127
C132
R123
C125
C124
C126
R121
C123
R122
Q105
C122
T101
C128
T102
L103
R124
C130
C131
Q106
C129
R125

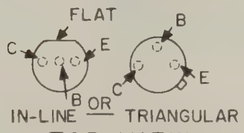
SEE DETAIL "C"


TERM. 1
TERM. 3

DETAIL "C"

L101 & L102 (ENLARGED)

LEAD IDENTIFICATION FOR Q101 - Q107

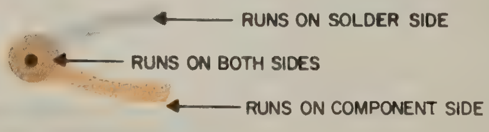

FLAT
C
E
B
B
C
E
IN-LINE
OR
TRIANGULAR

TOP VIEW

NOTE: LEAD ARRANGEMENT, & NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION. TAB INDICATES EMITTER LEAD.

* RAISED TAB ON COIL FORM INDICATES PIN 1 ON T101 THRU T108.

(19D423895, Rev. 0)
(19D423281, Sh. 2, Rev. 4)
(19D423281, Sh. 3, Rev. 4)


RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE

OUTLINE DIAGRAM

138—174 MHz EXCITER BOARD
19D423293G1 & G2

MOBILE RADIO

MASTR®

CHANNEL GUARD ENCODER/DECODER 19C321017G1 & G2
FOR
PE/PY MODELS
AND
Porta•Mobile II T.M.

Maintenance Manual LBI4870 G

DATAFILE FOLDER – DF5044

CHANNEL GUARD ENCODER/DECODER 19C321017G1 . G2

SPECIFICATIONS *

Tone Frequencies	71.9 Hz to 203.5 Hz
Frequency Stability	±0.4%
Current Drain	
Standby	4.37 Milliamperes
Decoded	4.66 Milliamperes
Encode	4.66 Milliamperes
Temperature Range	-30°C to +60°C (-22°F to +140°F)
Normal Input Voltage Requirements	+7.5 VDC

*ese specifications are intended primarily for the use of the serviceman. Refer to the appropriate Specification Sheet for the complete specifications.

GENERAL ELECTRIC

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Figure 5 - Typical Low Pass Filter 2
Figure 6 - Typical Decode Limiter Circuit 3
Figure 7 - Typical Decode Amplifier and Threshold Detector Circuit 3

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DESCRIPTION

Channel Guard 19C321017G1 and G2 is a continuous tone encoder/decoder for operation on tone frequencies in the 71.9 Hz to 203.5 Hz range. The encoder and the decoder operate on the same tone frequency, but can be modified to operate on two tone frequencies by adding connections to Pins 4 and 7 of P602, adding R604, R605 and XFL602, and using two Versatone Networks. The Encoder/Decoder assembly consists of descrete components and five thick film Integrated Circuits Modules. The Integrated Circuit Modules consist of Decode Module A601, Encode Module A602, Frequency Switchable Selective Amplifier (FSSA) A603 and two plug in Versatone Networks FL601 and FL602.

The Channel Guard is controlled by a switch on the control unit labeled CG "A"-"OFF"-"B" or CG "ON"-"OFF". Placing the switch labeled CG "A"-"OFF"-"B" in the "OFF" position disables the encoder and decoder circuits so that no tone is applied to the transmitter oscillator modules and all calls are monitored by the receiver. Placing the switch in an "A" or "B" position enables the decoder circuit so that calls will not be heard from the receiver until the proper Channel Guard tone is applied. Placing the switch labeled CG "ON"-"OFF" in the "OFF" position disables the decoder only.

For a functional diagram of the Channel Guard Encoder/Decoder refer to the troubleshoot procedures.

Typical diagrams of the Versatone Network, Phase Inverting Amplifier, Encode Limiter, Low Pass Filter, Decode Limiter, Amplifier and Threshold detector are provided in Figures 2 through 7. References to symbol numbers mentioned in the following text are found on the Schematic Diagram, Outline Diagram, and Parts List.

CIRCUIT ANALYSIS

Frequency Switchable Selective Amplifier

Frequency Switchable Selective Amplifier (FSSA) A603 is a highly stable active bandpass filter for the 71.9 Hz to 203.5 Hz frequency range. The selectivity of the filter is shifted across the bandpass frequency range by switching Versatone Networks in the filter circuit (see Figure 1).

In Figure 1, the gain of the FSSA is shown as a function of the tone frequency. The Tone Frequency is determined by the Tone Network connected in the FSSA circuit. When Tone Network A is in the circuit, the maximum gain occurs at FA. When Tone Network B is in the circuit, the maximum gain occurs at FB.

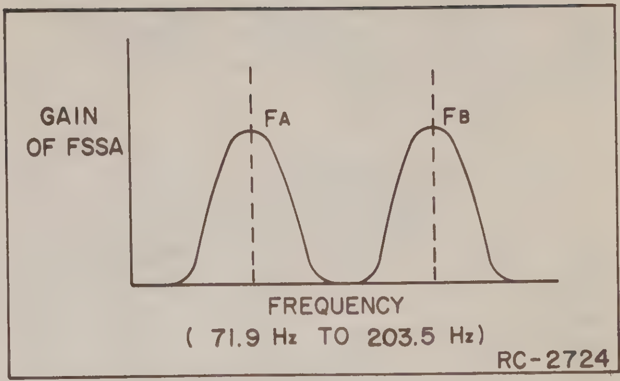

Figure 1 - Gain vs Frequency

Tone Networks

Versatone Networks FL601 and FL602 are parallel connected, precision resistor networks with associated switching transistors. A typical Versatone Network is shown in Figure 2. Pins 4 and 5 of the network are connected to ground. When a positive voltage is applied to Pin 3, Q1 will conduct. This disables Amplifier Q2 and feedback resistors R1, R2 and R3, effectively removing the network from the FSSA circuit.

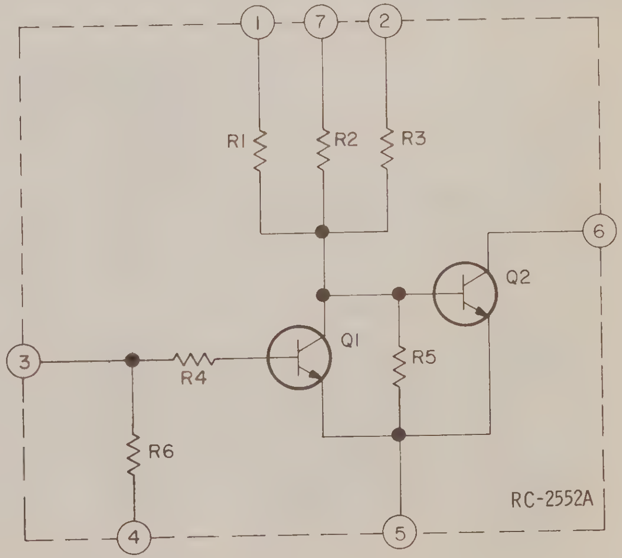

Figure 2 - Typical Versatone Network

Encode

The Channel Guard encode tone is generated by coupling the output of FSSA bandpass filter A603 back to its input through a phase inverting amplifier circuit and a limiter circuit. The output of the FSSA is coupled from A603-1 to the input of the phase inverting amplifier at A602-9. A typical phase inverting amplifier circuit is shown in Figure 3.

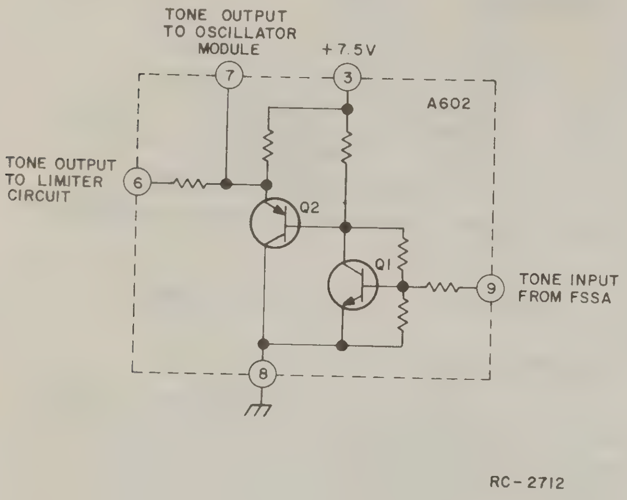
TONE OUTPUT
TO OSCILLATOR
MODULE
+7.5V
7
3
A602
TONE OUTPUT
TO LIMITER
CIRCUIT
6
Q2
Q1
9
TONE INPUT
FROM FSSA
8
RC-2712

Figure 3 - Typical Phase Inverting Amplifier

Amplifier Q1 provides 180° phase shift of the tone frequency at the output of emitter follower Q2. The output of the phase inverting amplifier circuit is coupled from A602-6 to the input of the limiter circuit at A602-5. A typical limiter circuit is shown in Figure 4.

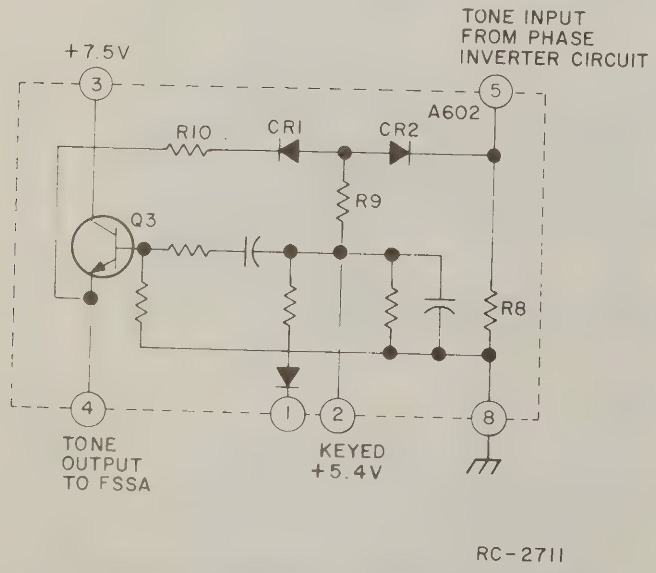
+7.5V
3
TONE INPUT
FROM PHASE
INVERTER CIRCUIT
5
A602
R10
CR1
CR2
R9
Q3
R8
4
TONE
OUTPUT
TO FSSA
1
2
KEYED
+5.4V
8
RC-2711

Figure 4 - Typical Encode Limiter Circuit

Limiting network CR1, CR2, R8, R9 and R10 sets the tone output coupled from A602-4 to the input of the FSSA (A603-12) at 53 milli-volts peak to peak.

The limiter circuit is also used as an encode switch. Keying the transmitter applies +5.4 Volts to A602-2. This forward biases Limiter diodes CR1 and CR2 and momentarily turns Q3 on. Forward biasing CR1 and CR2 allows the circuit to oscillate. Momentarily turning Q3 on starts the circuit oscillating. The tone frequency is determined by the tone network connected in the FSSA circuit.

The tone output of the encoder circuit is taken from A602-7 and coupled through modulation adjustment R601 to the transmitter oscillator modules.

Decode

Audio, containing the correct tone frequency from R707-3 (Volume Hi), is coupled to Pin 1 of Decode Module A601. Pin 1 of A601 is the input of an active, three stage, low pass filter. The low pass filter attenuates frequencies over 205 Hz. A typical low pass filter is shown in Figure 5. The output of the low pass filter at A601-15 is applied to A601-14. A601-14 is the input of a limiter circuit, limiting the output at A601-13 to 55 millivolts peak to peak. A typical limiter circuit is shown in Figure 6. The output from the limiter is coupled to Pin 12 of FSSA A603. Since the tone is the proper frequency the FSSA will allow it to pass. The output of the FSSA is coupled from A603-1 to A601-3. A601-3 is the input to an amplifier circuit. The output of the amplifier at A601-4 is coupled to the input of a threshold detector at A601-6. A typical amplifier and threshold detector circuit is shown in Figure 7. When a tone is present Q6 will conduct causing Q7 to conduct and +7.5 VDC to be on the output of the threshold detector circuit (A601-10). The +7.5 Volts is applied to the Squelch switching transistor on the receiver Audio PA module. The receiver now operates on noise squelch, permitting the call to be monitored.

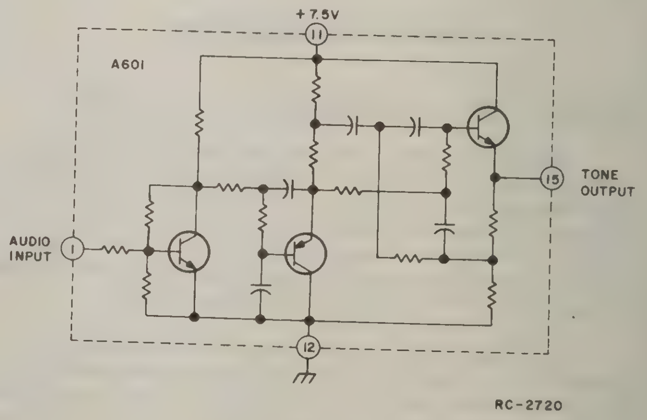
+7.5V
11
A601
15
TONE
OUTPUT
AUDIO
INPUT
1
12
RC-2720

Figure 5 - Typical Low Pass Filter

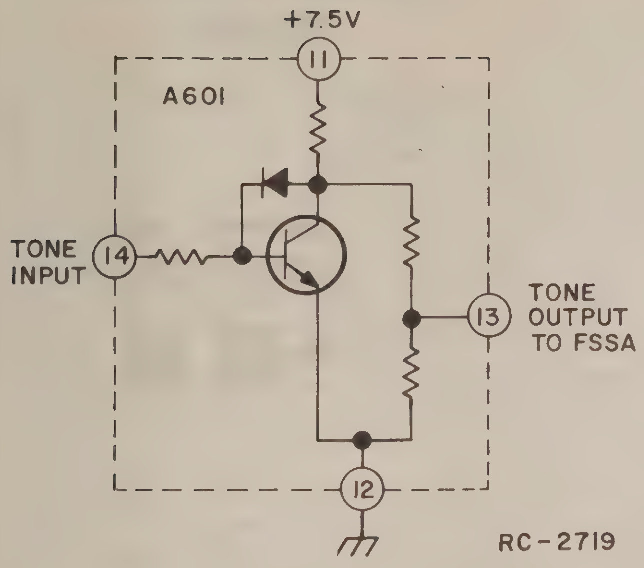

Figure 6 - Typical Decode Limiter Circuit

PE Tone Control

Tone Control Board 19B219505G2 is used with eight-frequency PE to disable undesired tones. For example, placing frequency select switch S1 in channel one position, where B tone is not desired, forward biases diode CR1 with 5.4 Volts. The output of CR1 is applied through TONE B DISABLE (P602/P603-7) to Pin 7 of Versatone Network FL602, holding FL602 OFF.

For assembly instructions of diodes on Tone Control Board 19B219505G2, refer to the Interconnection Diagram for eight-frequency PE, listed in the Table of Contents.

PM II Automatic Tone Select

Diodes CR1013 through CR1036 mounted on the system disable undesired tones. For example, placing frequency select switch S704 in channel four position, where no B tone is desired, forward biases CR1018 with 5.4 Volts. The output of CR1018 is applied through TONE B DISABLE (P1-7 and J601-7) to Pin 3 of Versatone Network FL602, holding FL602 off.

For assembly of diodes on the system board, refer to the Interconnection Diagrams for Automatic Tone Select listed in the Table of Contents. Also refer to Maintenance Manual LBI30100 for portable radios or Maintenance Manual LBI30285 for mobile, industrial or motorcycle radios.

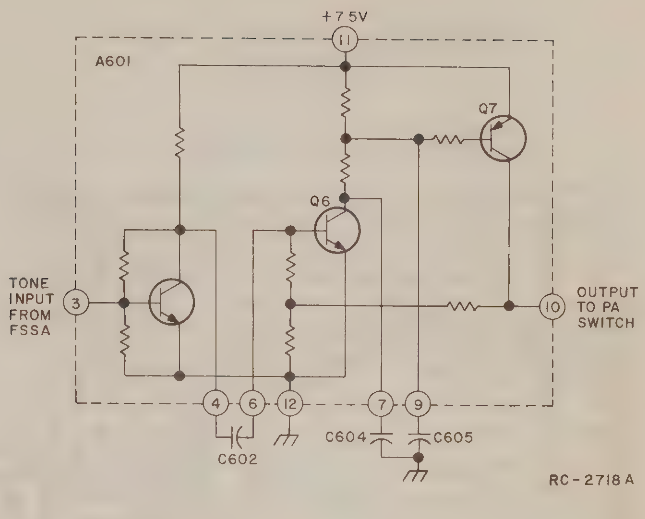

Figure 7 - Typical Amplifier & Threshold Detector Circuit

PM II Automatic Monitor

Automatic Monitor Board 19B226856G1 and diodes CR1001 through CR1012, mounted on the system board, disable Channel Guard operation so a channel can automatically be monitored. For example, placing frequency select switch S704 in channel four, where it is desirable to monitor the channel without Channel Guard, forward biases CR1006 and applies a 5.4 Volts to P2 of Automatic Monitor Board 19B226856G1. The 5.4 Volts applied to P2 causes transistor Q1 to conduct. Transistor Q1 conducting causes transistor Q1 on the system board to conduct, activating the tone switch on the receiver board. Activating the Tone switch causes the receiver to operate on noise squelch.

For assembly of diodes and Automatic Monitor Board, refer to the Interconnection Diagrams for Automatic Monitor listed in the Table of Contents. Also refer to Maintenance Manual LBI30100 for portable radios and Maintenance manual LBI30285 for mobile, industrial or motorcycle radios.

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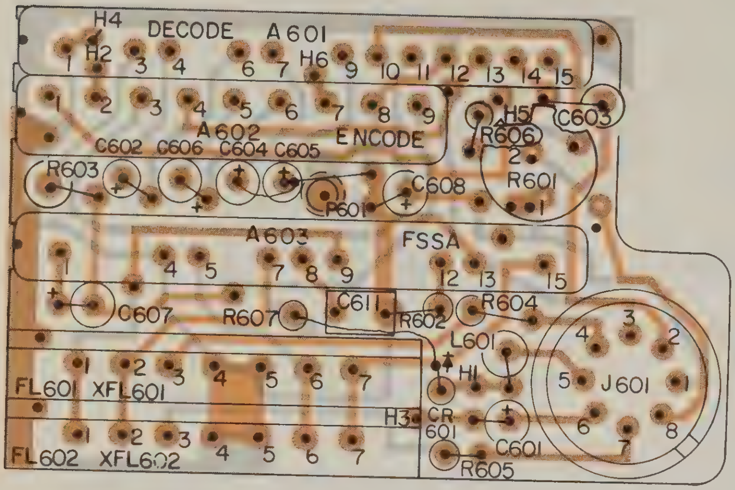
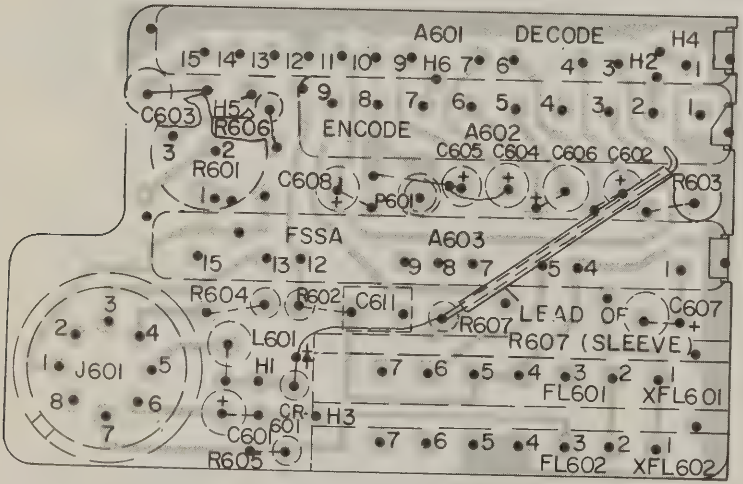
CHANNEL GUARD BOARD
(19C321017 G1)

COMPONENT SIDE


H4
DECODE
A601
H2
H6
H5
C603
A602
ENCODE
R606
C602 C606 C604 C605
R603
C608
R601
P601
A603
FSSA
C607
R607
C611
R602
R604
L601
H1
J601
FL601 XFL601
FL602 XFL602
H3
CR601
C601
R605

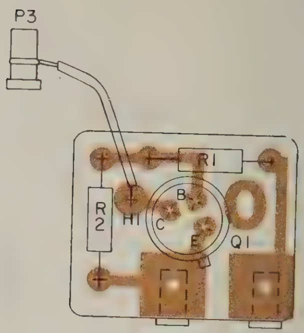
(19C321528, Rev. 1)
(19D417783, Sh. 2, Rev. 6)
(19D417783, Sh. 3, Rev. 5)

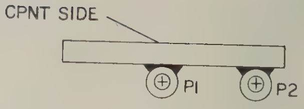
SOLDER SIDE


A601
DECODE
H4
H6
H2
C603
H5
R606
ENCODE
A602
C605 C604 C606 C602
R601
C608
P601
R603
FSSA
A603
R604
R602
C611
LEAD OF
C607
R607
R607 (SLEEVE)
L601
H1
J601
FL601
XFL601
CR601
H3
C601
R605
FL602
XFL602

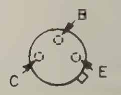
(19C321528, Rev. 1)
(19D417783, Sh. 2, Rev. 6)

AUTOMATIC MONITOR
19B226856


P3
R1
R2
H1
B
C
E
Q1


CPNT SIDE
P1
P2

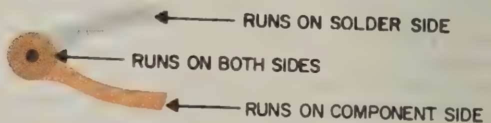
LEAD IDENTIFICATION
FOR Q1



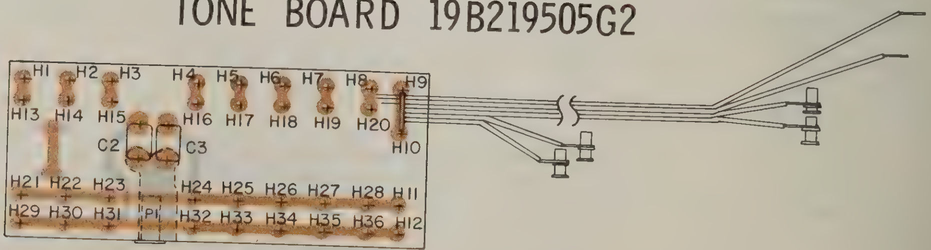
TRIANGULAR
TOP VIEW

NOTE: LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

(19B232249, Rev. 0)
(19C321617, Sh. 2, Rev. 0)
(19C321617, Sh. 3, Rev. 0)


RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE

TONE BOARD 19B219505G2

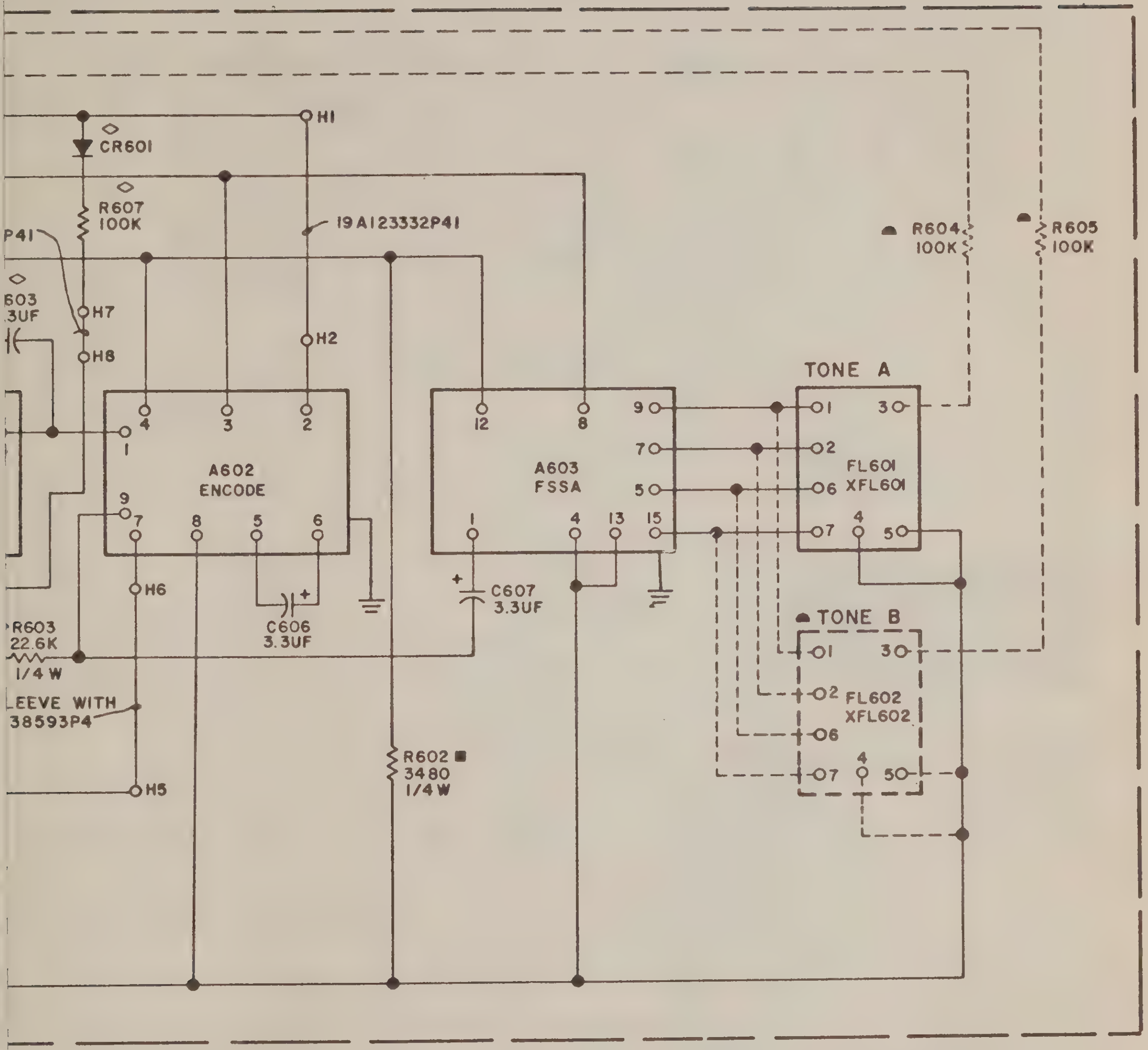

H1 H2 H3 H4 H5 H6 H7 H8 H9
H13 H14 H15 H16 H17 H18 H19 H20
H10
C2
C3
H21 H22 H23 H24 H25 H26 H27 H28 H11
H29 H30 H31 P1 H32 H33 H34 H35 H36 H12

(19B232259, Rev. 0)
(19B219488, Sh. 1, Rev. 1)
(19B219488, Sh. 2, Rev. 1)

OUTLINE DIAGRAM

CHANNEL GUARD ENCODE/DECODE
19C321017G1

E/DECODE OR ENCODE ONLY


H1
CR601
R607
100K
P41
19A123332P41
603
.3UF
H7
H8
H2
R604
100K
R605
100K
TONE A
A602
ENCODE
4
3
2
1
9
7
8
5
6
A603
FSSA
12
8
9
7
5
1
4
13
15
01
2
06
07
30
4
50
FL601
XFL601
H6
C606
3.3UF
C607
3.3UF
TONE B
R603
22.6K
1/4 W
LEEVE WITH
38593P4
FL602
XFL602
R602
3480
1/4 W
H5

NLESS

DDE ONLY. (9 PARTS, 1 JUMPER)
DDE/DECODE. (1 PART)
BAND (30-50 MHz). (1 PART)

(406-512 MHz). (1 PART)
GLE TONE ENCODE/DECODE OR ENCODE ONLY. (3 PARTS)
38 MHZ ONLY. PART OF KIT 19A130285G7

RE 1/8 WATT UNLESS
IFIED AND RESISTOR
UNLESS FOLLOWED BY
MEG = 1,000,000 OHMS.
S IN PICOFARADS (EQUAL
ARADS) UNLESS FOLLOWED
ADS. INDUCTANCE VALUES
UNLESS FOLLOWED BY
OR H=HENRYS.

IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.

(19D423936, Rev. 4)

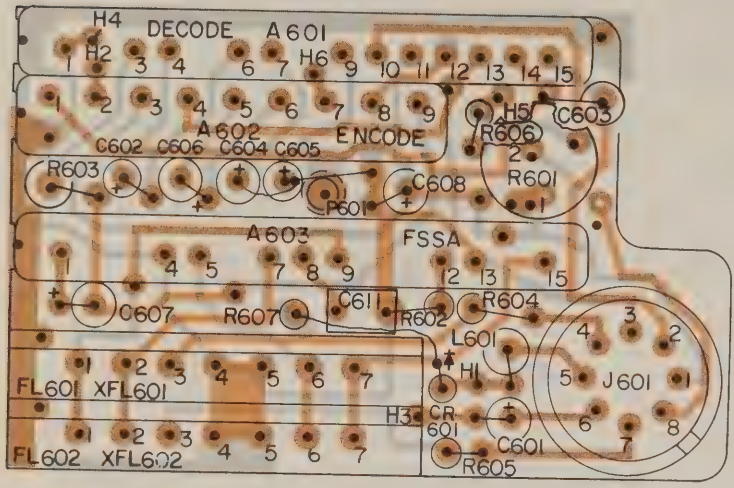
SCHEMATIC DIAGRAM

CHANNEL GUARD ENCODER/DECODER
19C321017G1 & G2

Issue 5

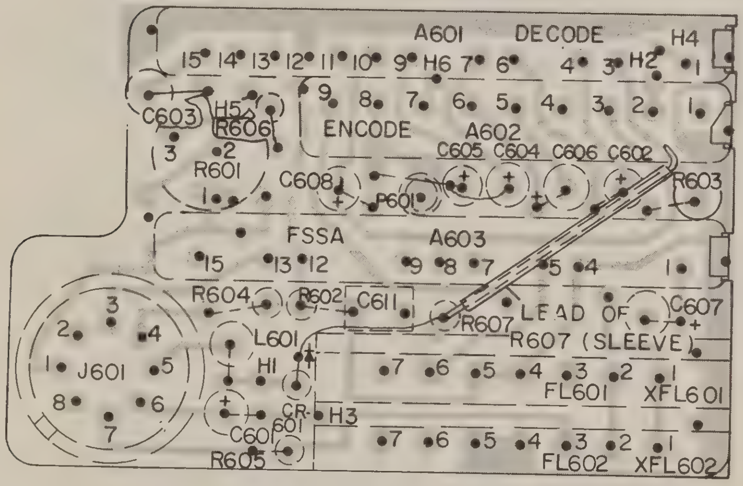
CHANNEL GUARD BOARD
(19C321017 G1)

COMPONENT SIDE


H4
DECODE
A601
H2
H6
H5
C603
R606
A602
ENCODE
C602
C606
C604
C605
R603
C608
R601
P601
A603
FSSA
C611
R604
C607
R607
R602
L601
H1
J601
FL601
XFL601
H3
CR601
C601
FL602
XFL602
R605

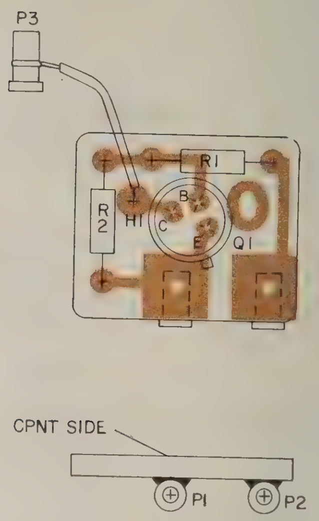
(19C321528, Rev. 1)
(19D417783, Sh. 2, Rev. 6)
(19D417783, Sh. 3, Rev. 5)

SOLDER SIDE

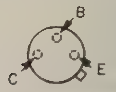

A601
DECODE
H4
H6
H2
C603
H5
R606
ENCODE
A602
C605
C604
C606
C602
R601
C608
P601
R603
FSSA
A603
R604
R602
C611
R607
LEAD OF
C607
R607 (SLEEVE)
L601
J601
H1
FL601
XFL601
CR601
H3
C601
R605
FL602
XFL602

(19C321528, Rev. 1)
(19D417783, Sh. 2, Rev. 6)

AUTOMATIC MONITOR
19B226856


P3
R1
R2
H1
B
C
E
Q1
CPNT SIDE
P1
P2

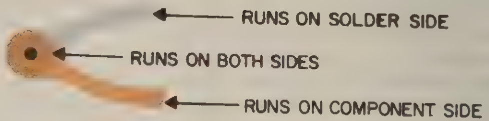
LEAD IDENTIFICATION FOR Q1



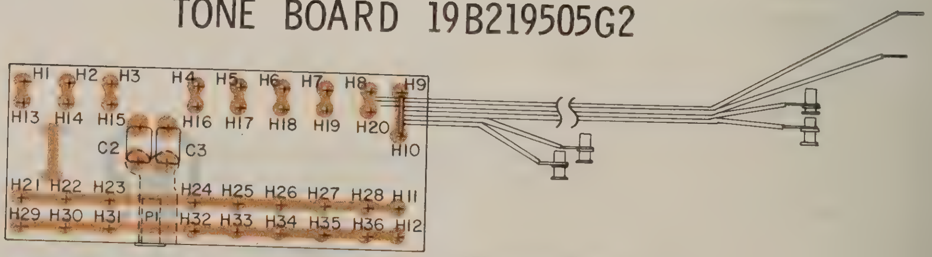
TRIANGULAR
TOP VIEW

NOTE: LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

(19B232249, Rev. 0)
(19C321617, Sh. 2, Rev. 0)
(19C321617, Sh. 3, Rev. 0)


RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE

TONE BOARD 19B219505G2


H1
H2
H3
H4
H5
H6
H7
H8
H9
H13
H14
H15
H16
H17
H18
H19
H20
H10
C2
C3
H21
H22
H23
H24
H25
H26
H27
H28
H11
H29
H30
H31
P1
H32
H33
H34
H35
H36
H12

(19B232259, Rev. 0)
(19B219488, Sh. 1, Rev. 1)
(19B219488, Sh. 2, Rev. 1)

OUTLINE DIAGRAM

CHANNEL GUARD ENCODE/DECODE
19C321017G1

PARTS LIST

LBI-4871B

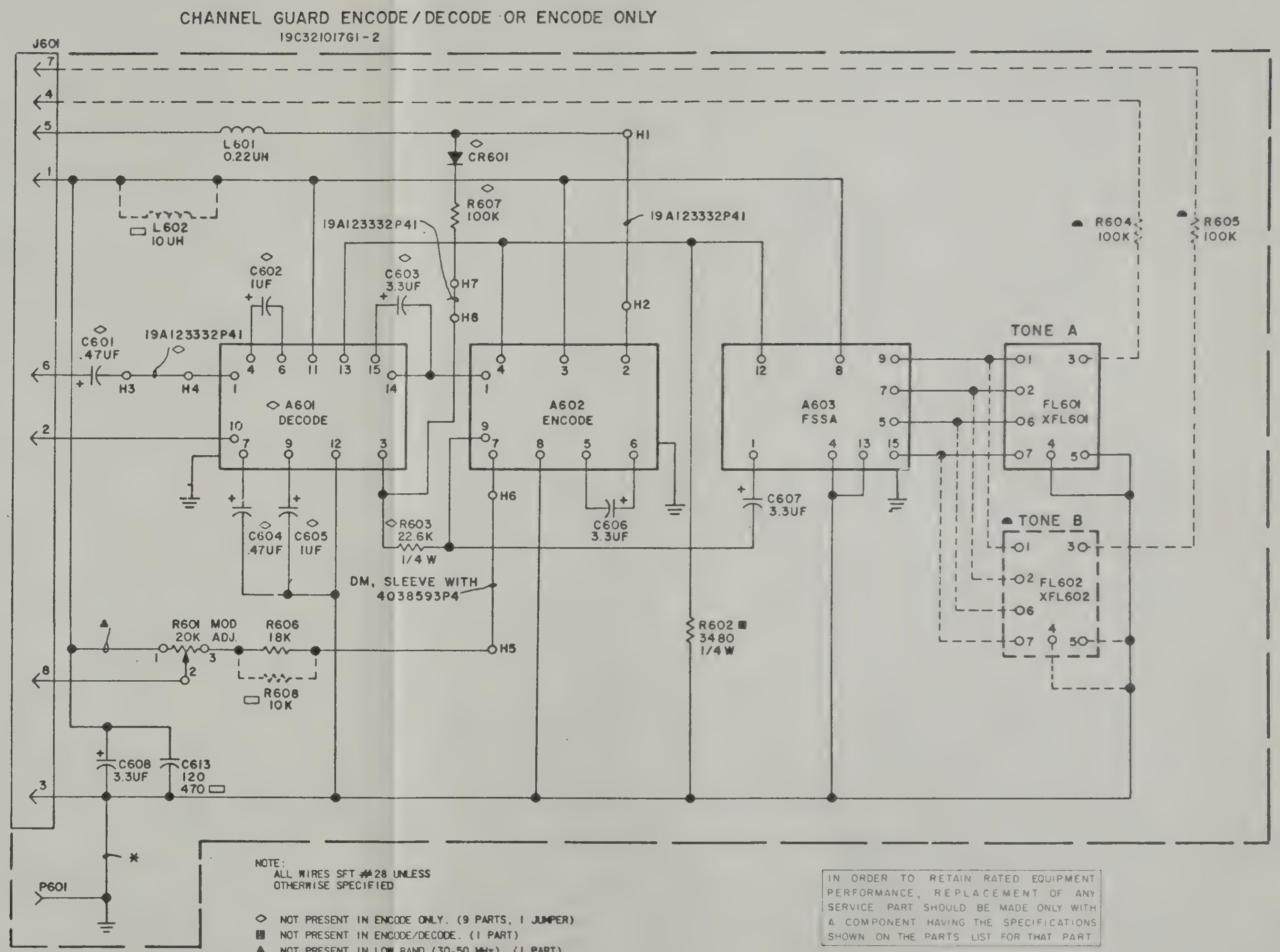
CHANNEL GUARD
19C321017G1 ENCODE/DECODE
19C321017G2 ENCODE ONLY

SYMBOL	GE PART NO.	DESCRIPTION
A601	19D417763G1	Decoder.
A602	19C321133G1	Encoder.
A603	19D417833G1	Selective Amplifier.
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C601	5491674P27	Tantalum: .47 µf ±20%, 35 VDCW; sim to Sprague Type 162D.
C602	5491674P1	Tantalum: 1.0 µf +40-20%, 10 VDCW; sim to Sprague Type 162D.
C603	5491674P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C604	5491674P27	Tantalum: .47 µf ±20%, 35 VDCW; sim to Sprague Type 162D.
C605	5491674P1	Tantalum: 1.0 µf +40-20%, 10 VDCW; sim to Sprague Type 162D.
C606 thru C608	5491674P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C611	19A116114P7068	Ceramic: 120 pf ±5%, 100 VDCW; temp coef -750 PPM.
		- - - - - - - - DIODES AND RECTIFIERS - - - - - -
CR601	19A115250P1	Silicon.
		- - - - - - - - - - TONE NETWORKS - - - - - - - - - -
		NOTE: When reordering give GE Part Number and specify exact frequency needed.
FL601 and FL602	19C320291G1	Versatone Network: 71.9-203.5 Hz.
		- - - - - - - - JACKS AND RECEPTACLES - - - - - - - -
J601	19A116122P1	Terminal, feed-thru: sim to Warren 1-B-2994-4.
		- - - - - - - - - - - - INDUCTORS - - - - - - - - - -
L601	19B209420P105	Coil, RF: 0.22 µh ±10%, 0.14 ohms DC res max; sim to Jeffers 4416-5.
		- - - - - - - - - - - - - PLUGS - - - - - - - - - - -
P601	19A115834P4	Contact, electrical: sim to AMP 2-332070-9.
		- - - - - - - - - - RESISTORS - - - - - - - - - - -
R601	19A116412P6	Variable, cermet: 20,000 ohms ±10%, 1/2 w; sim to Helipot Model 62 PF.
R602	19C314256P23481	Metal film: 3480 ohms ±1%, 1/4 w.
R603	19C314256P22262	Metal film: 22,600 ohms ±1%, 1/4 w.
R606	3R151P183J	Composition: 18,000 ohms ±5%, 1/8 w.
R607	3R151P104K	Composition: 100,000 ohms ±10%, 1/8 w.
		- - - - - - - - - - - - SOCKETS - - - - - - - - - -
XFL601 and XFL602		Socket. Includes:
	19D416714P1	Shell.
	19B219681P1	Contact, electrical.
		- - - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19B216316P1	Insulator. (Used with J601).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

CHANNEL GUARD TONE FREQUENCIES

71.9 Hz
77.0
82.5
88.5
94.8
100.0
103.5
107.2
110.9
114.8
118.8
123.0
127.3
131.8
136.5
141.3
146.2
151.4
156.7
162.2
167.9
173.8
179.9
186.2
192.8
203.5


CHANNEL GUARD ENCODE/DECODE OR ENCODE ONLY
19C321017G1-2
J601
7
4
5
1
6
2
8
3
L601 0.22UH
CR601
HI
R607 100K
19A123332P41
19A123332P41
L602 10UH
C602 1UF
C603 3.3UF
H7
H8
H2
C601 .47UF
19A123332P41
H3
H4
A601 DECODE
A602 ENCODE
A603 FSSA
C604 .47UF
C605 1UF
R603 22.6K 1/4 W
C606 3.3UF
C607 3.3UF
H6
DM, SLEEVE WITH 4038593P4
R601 MOD 20K ADJ.
R606 18K
R608 10K
H5
R602 3480 1/4 W
C608 3.3UF
C613 120 470
TONE A
FL601 XFL601
TONE B
FL602 XFL602
R604 100K
R605 100K
P601

NOTE:
ALL WIRES SFT #28 UNLESS
OTHERWISE SPECIFIED

◇ NOT PRESENT IN ENCODE ONLY. (9 PARTS, 1 JUMPER)
■ NOT PRESENT IN ENCODE/DECODE. (1 PART)
▲ NOT PRESENT IN LOW BAND (30-50 MHz). (1 PART)

✱ NOT PRESENT IN 450 (406-512 MHz). (1 PART)
● NOT PRESENT IN SINGLE TONE ENCODE/DECODE OR ENCODE ONLY. (3 PARTS)
▭ PRESENT IN 66-88 MHZ ONLY. PART OF KIT 19A130285G7

IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART

SEE APPLICABLE PRODUCTION CHANGE SHEETS IN INSTRUCTION BOOK SECTION DEALING WITH THIS UNIT, FOR DESCRIPTION OF CHANGES UNDER EACH REVISION LETTER.

THIS ELEM DIAG APPLIES TO	
MODEL NO	REV LETTER

ALL RESISTORS ARE 1/8 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.

(19D423936, Rev. 4)

SCHEMATIC DIAGRAM

CHANNEL GUARD ENCODER/DECODER
19C321017G1 & G2

Issue 5

DESCRIPTION
- - - - - - - - - - RESISTORS - - - - - - - - -
Composition: 47 ohms ±5%, 1/4 w.
- - - - - - - - - MISCELLANEOUS - - - - - - - -
Decorative cap. (Used with S601).
Decorative cap. (Used with S602).
Seal. (Used with S601, S602).
Washer, fiber. (Used with S601, S602).
Shield. (Located by antenna tube).
Insulator. (Used with Channel Guard Board).

PRODUCTION CHANGES

pment to improve performance or to simplify circuits
"Revision Letter", which is stamped after the model
The revision stamped on the unit includes all pre-
efer to the Parts List for descriptions of parts
evisions.

ard Mod Kit 19A130285G1, 2 & 3

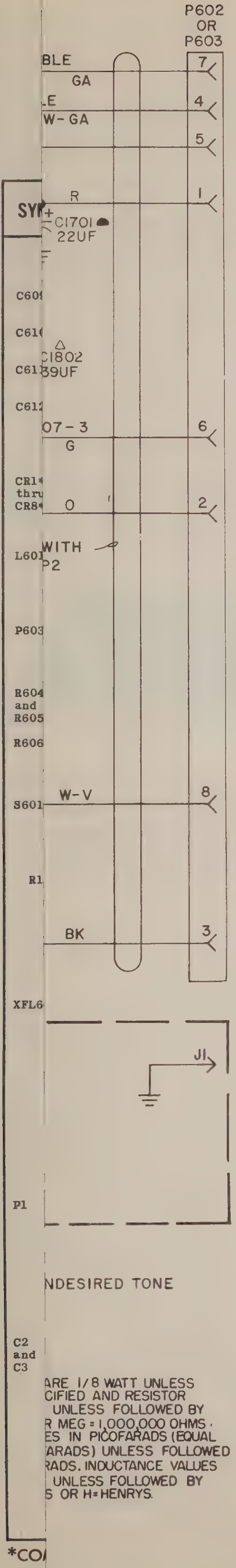
RF filtering. Added C612.

RF filtering. Added R606, C611 and L601.

ard Mod Kit 19A130285G3

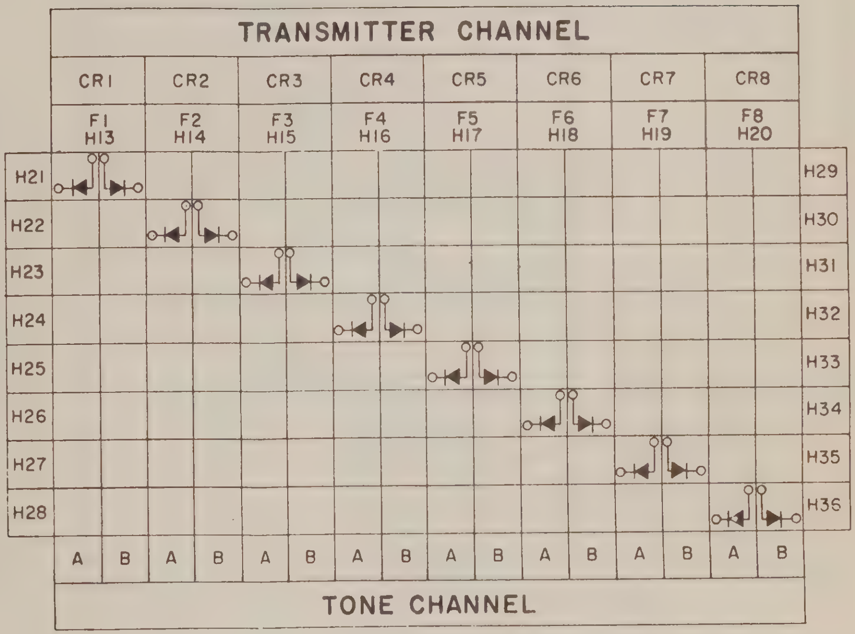
operation. Changed wiring diagram 19D417799

ot present in 2 tone encode
applications.


P602
OR
P603
BLE
GA
LE
W-GA
R
SYM
+
C1701
22UF
C601
C61
C1802
39UF
C61
C61
07-3
G
CR1
thru
CR8*
O
WITH
P2
L601
P603
R604
and
R605
R606
W-V
S601
R1
BK
XFL6
J1
P1
NDESIRED TONE
C2
and
C3
ARE 1/8 WATT UNLESS
CIFIED AND RESISTOR
UNLESS FOLLOWED BY
R MEG = 1,000,000 OHMS.
ES IN PICOFARADS (EQUAL
ARADS) UNLESS FOLLOWED
RADS. INDUCTANCE VALUES
UNLESS FOLLOWED BY
S OR H = HENRYS.
*CO
7
4
5
1
6
2
8
3

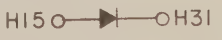
THIS ELEM DIAG APPLIES TO

MODEL NO	REV LETTER
PL19A130285G4	C
PL19A130285G5	C
PL19A137882G1	

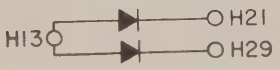

TRANSMITTER CHANNEL
CR1
CR2
CR3
CR4
CR5
CR6
CR7
CR8
F1 H13
F2 H14
F3 H15
F4 H16
F5 H17
F6 H18
F7 H19
F8 H20
H21
H22
H23
H24
H25
H26
H27
H28
H29
H30
H31
H32
H33
H34
H35
H36
A
B
A
B
A
B
A
B
A
B
A
B
A
B
A
B
TONE CHANNEL

USE THE ABOVE CHART FOR ASSEMBLING DIODES IN THE TWO TONE SELECTOR BOARD 19B219505G1 OR G2. THE DIODES DISABLES THE UNDESIRED TONE.

SAMPLE: 1 IF TONE B IS TO BE USED ON F3, THEN FIND F3 ON CHART. GO DOWN COLUMN UNTIL YOU FIND A DIODE. THE DIODE IN COLUMN B GIVES THE HOLE NUMBER AND DIRECTION THE DIODE SHOULD BE ASSEMBLED. DIODE IN SAMPLE IS CONNECTED FROM H15 TO H31



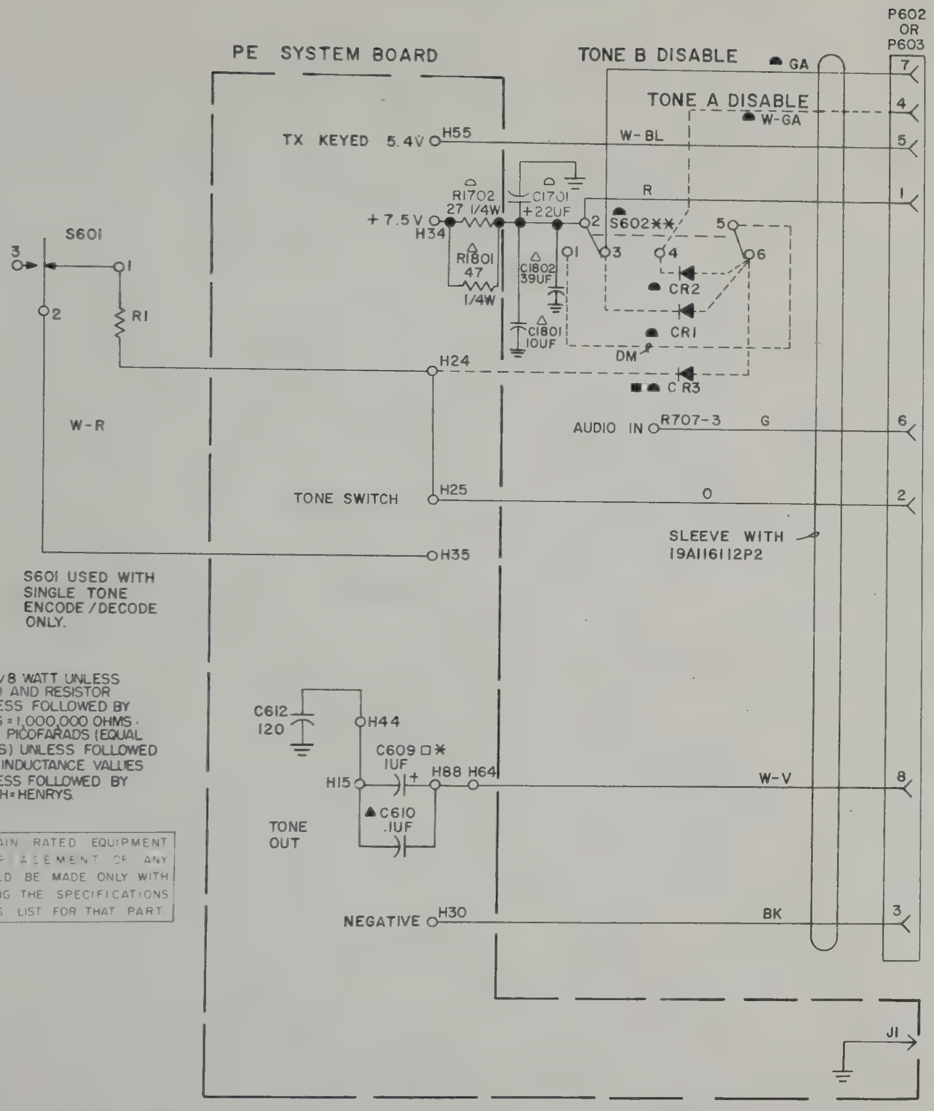
SAMPLE: 2 IF F1 HAS NO TONES, THEN FIND F1 ON CHART GO DOWN COLUMN UNTIL YOU FIND A DIODE. THE DIODES IN COLUMN A & B GIVES THE HOLE NUMBER AND DIRECTION THE DIODES SHOULD BE ASSEMBLED TO GIVE YOU NO TONE. DIODES IN SAMPLE IS CONNECTED FROM H13 TO H21 AND H13 TO H29.



(19C321209, Rev. 0)

INTERCONNECTION DIAGRAM

EIGHT-FREQUENCY PE RADIO



S601 USED WITH SINGLE TONE ENCODE /DECODE ONLY.

ALL RESISTORS ARE 1/8 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.

IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.

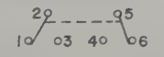
THIS ELEM DIAG APPLIES TO	
MODEL NO	REV LETTER
PL19A130285G1	B
PL19A130285G2	B
PL19A130285G3	C
PL19A137882G1	

NOTE:
ALL WIRES SFT #28 UNLESS OTHERWISE SPECIFIED.

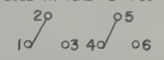
△ PRESENT ONLY WITH OPTION 4422 OR 4424 AND CHANNEL GUARD
■ CR3 NOT PRESENT IN 2 TONE ENCODE ONLY APPLICATIONS.
▲ NOT PRESENT IN LOW BAND (30-50 MHz), OR HIGH BAND PY (150-174 MHz) (1 PART)
□ NOT PRESENT IN HIGH BAND PE (132-174 MHz) (1 PART)
✱ | NOT PRESENT IN 450 (406-512 MHz). (1 PART)
● NOT PRESENT IN SINGLE TONE ENCODE/DECODE OR ENCODE ONLY. (7 PARTS, 2 WIRES)
○ USED ONLY WITH INTRINSICALLY SAFE RADIO.

✱✱ S602 SHOWN IN TONE "A" POSITION

S602 IN OFF POSITION



S602 IN TONE "B" POSITION



TO ENCODE TONE "A" IN OFF POSITION CLIP CR2.
TO ENCODE TONE "B" IN OFF POSITION CLIP CR1.

INTERCONNECTION DIAGRAM

PE/PY RADIO

(19D417799, Rev. 9)

PARTS LIST

LBI30524B

PE/PY CHANNEL GUARD MOD KIT
19A130285G1 1 TONE W MONITOR SWITCH
19A130285G2 1 TONE WITHOUT MONITOR SWITCH
19A130285G3 2 TONE W A-OFF-B SWITCH

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - - CAPACITORS - - - - - - - - - -
C609	5491674P1	Tantalum: 1.0 µf +40-20%, 10 VDCW; sim to Sprague Type 162D.
C610	19A116192P14	Ceramic: .1 µf ±20%, 50 VDCW; sim to Erie USCC CW120C104-M2.
C611*	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-A050-W5R-471M. Added by REV B.
C612*	19A116114P7068	Ceramic: 120 pf ±5%, 100 VDCW; temp coef -750 PPM. Added by REV A.
		- - - - - - - - - - - INDUCTORS - - - - - - - - - -
L601*	19B209420P125	Coil, RF: 10.0 µh ±10%, 3.10 ohms DC res max; sim to Jeffers 4446-4K. Added by REV B.
		- - - - - - - - - - - PLUGS - - - - - - - - - -
P602	19B226481G2	Plug: 8 contacts.
P603	19B226481G1	Plug: 8 contacts.
		- - - - - - - - - - - RESISTORS - - - - - - - - - -
R604 and R605	3R151P104K	Composition: 100K ohms ±10%, 1/8 w.
R606*	3R151P103J	Composition: 10K ohms ±5%, 1/8 w. Added by REV B.
		- - - - - - - - - - - SWITCHES - - - - - - - - - -
S601		SWITCH ASSEMBLY 19A127833G1
		- - - - - - - - - - - RESISTORS - - - - - - - - - -
R1	3R151P201J	Composition: 200 ohms ±5%, 1/8 w.
		- - - - - - - - - - - SWITCHES - - - - - - - - - -
	19A116648P6	Toggle: SPDT; sim to C and K Components 7101SDG.
S602		SWITCH ASSEMBLY 19A130252G1
		- - - - - - - - DIODES AND RECTIFIERS - - - - - -
CR1 and CR2	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
CR3	19A116052P2	Silicon.
		- - - - - - - - - - - SWITCHES - - - - - - - - - -
S1	19A116648P2	Toggle: DPDT; sim to C and K Components 7211SDG.
		- - - - - - - - - - - SOCKETS - - - - - - - - - -
XFL602		Socket. Includes:
	19D416714P1	Socket.
	19B219681P1	Contact, electrical.
		MODIFICATION KIT 19A137882G1
		- - - - - - - - - - - CAPACITORS - - - - - - - - - -
C1801	5491674P37	Tantalum: 10 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C1802	5491674P30	Tantalum: 39 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
		- - - - - - - - - - - RESISTORS - - - - - - - - - -
R1901	3R152P470J	Composition: 47 ohms ±5%, 1/4 w.
		- - - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19B216926G1	Decorative cap. (Used with S601).
	19B216926P2	Decorative cap. (Used with S602).
	19C320721P1	Seal. (Used with S601, S602).
	4035306P2	Washer, fiber. (Used with S601, S602).
	19A130289P1	Shield. (Located by antenna tube).
	19A136802P1	Insulator. (Used with Channel Guard Board).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

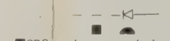
PRODUCTION CHANGES

Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter", which is stamped after the model number of the unit. The revision stamped on the unit includes all previous revisions. Refer to the Parts List for descriptions of parts affected by these revisions.

REV. A - Channel Guard Mod Kit 19A130285G1, 2 & 3
To improve RF filtering. Added C612.

REV. B - To improve RF filtering. Added R606, C611 and L601.

REV. C - Channel Guard Mod Kit 19A130285G3
To improve operation. Changed wiring diagram 19D417799 to:



■CR3 not present in 2 tone encode only applications.

PARTS LIST

LBI30525B

PE CHANNEL GUARD MOD KIT
19A130285G4 2 TONE W TONE CONTROL AND MONITOR SWITCH
19A130285G5 2 TONE WITH TONE CONTROL

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - - CAPACITORS - - - - - - - - - -
C609	5491674P1	Tantalum: 1.0 µf +40-20%, 10 VDCW; sim to Sprague Type 162D.
C610	19A116192P14	Ceramic: .1 µf ±20%, 50 VDCW; sim to Erie USCC CW120C104-M2.
C611*	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-A050-W5R-471M. Added by REV C.
C612*	19A116114P7068	Ceramic: 120 pf ±5%, 100 VDCW; temp coef -750 PPM. Added by REV B.
		- - - - - - - - - DIODES AND RECTIFIERS - - - - - -
CR1* thru CR8*	5494922P1	Silicon; sim to Type 1N456. Added by REV A.
		- - - - - - - - - - - INDUCTORS - - - - - - - - - -
L601*	19B209420P125	Coil, RF: 10.0 µh ±10%, 3.10 ohms DC res max; sim to Jeffers 4446-4K. Added by REV C.
		- - - - - - - - - - - - PLUGS - - - - - - - - - - -
P603	19B226481G1	Plug: 8 contacts.
		- - - - - - - - - - - - RESISTORS - - - - - - - - - -
R604 and R605	3R151P104K	Composition: 100K ohms ±10%, 1/8 w.
R606*	3R151P103J	Composition: 10K ohms ±5%, 1/8 w. Added by REV C.
		- - - - - - - - - - - SWITCHES - - - - - - - - - - -
S601		SWITCH ASSEMBLY 19A127833G1
		- - - - - - - - - - - RESISTORS - - - - - - - - - -
R1	R151P201J	Composition: 200 ohms ±5%, 1/8 w.
		- - - - - - - - - - - SWITCHES - - - - - - - - - - -
	19A116648P6	Toggle: SPDT; sim to C and K Components 7101SDG.
		- - - - - - - - - - - SOCKETS - - - - - - - - - - -
XFL602		Socket. Includes shell and contacts. (Order separarely).
	19D416714P1	Socket.
	19B219681P1	Contact, electrical.
		TONE BOARD FOR 8 FREQUENCY PE 19B219505G1 (Deleted by REV A)
		- - - - - - - - - - - - PLUGS - - - - - - - - - - -
P1	19A115834P4	Contact, electrical: sim to AMP 2-332070-9.
		TONE BOARD FOR 8 FREQUENCY PE 19B219505G2 (Added by REV A)
		- - - - - - - - - - - CAPACITORS - - - - - - - - - -
C2 and C3	19A116114P10074	Ceramic: 180 pf ±5%, 100 VDCW; temp coef -3300 PPM.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - - - - PLUGS - - - - - - - - - - -
P1	19A115834P4	Contact, electrical: sim to AMP 2-332070-9.
		MODIFICATION KIT 19A137882G1
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1801	5491674P37	Tantalum: 10 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C1802	5491674P30	Tantalum: 39 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
		- - - - - - - - - - - RESISTORS - - - - - - - - - -
R1901	3R152P470J	Composition: 47 ohms ±5%, 1/4 w.
		- - - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19A115834P4	Contact, electrical: sim to AMP 2-332070-9. (Quantity 4- Used with 8 frequency Tone Board).
	19B219532G1	Cable. (Used with 8 frequency Tone Board).
	19B216926G1	Decorative cap. (Used with S601).
	19C320721P1	Seal. (Used with S601).
	4035306P2	Washer, fiber. (Used with S601).
	19A130289P1	Shield. (Located by antenna tube).
	19A136802P1	Insulator. (Used with Channel Guard Board).

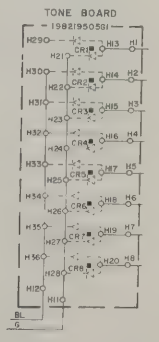
PRODUCTION CHANGES

Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter", which is stamped after the model number of the unit. The revision stamped on the unit includes all previous revisions. Refer to the Parts List for descriptions of parts affected by these revisions.

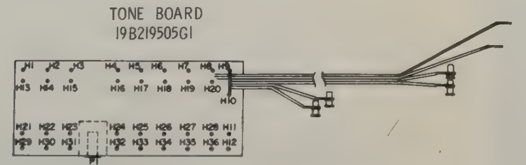
REV. A - Channel Guard Mod Kit 19A130285G4 & G5

To improve RF filtering. Added C2 and C3 to Tone Board 19B219505G1 making a 19B219505G2.

Schematic Diagram Was:


TONE BOARD
19B219505G1
H29
H21
H30
H13
H1
H14
H2
CR1
CR2
BL
G

Outline Diagram Was:

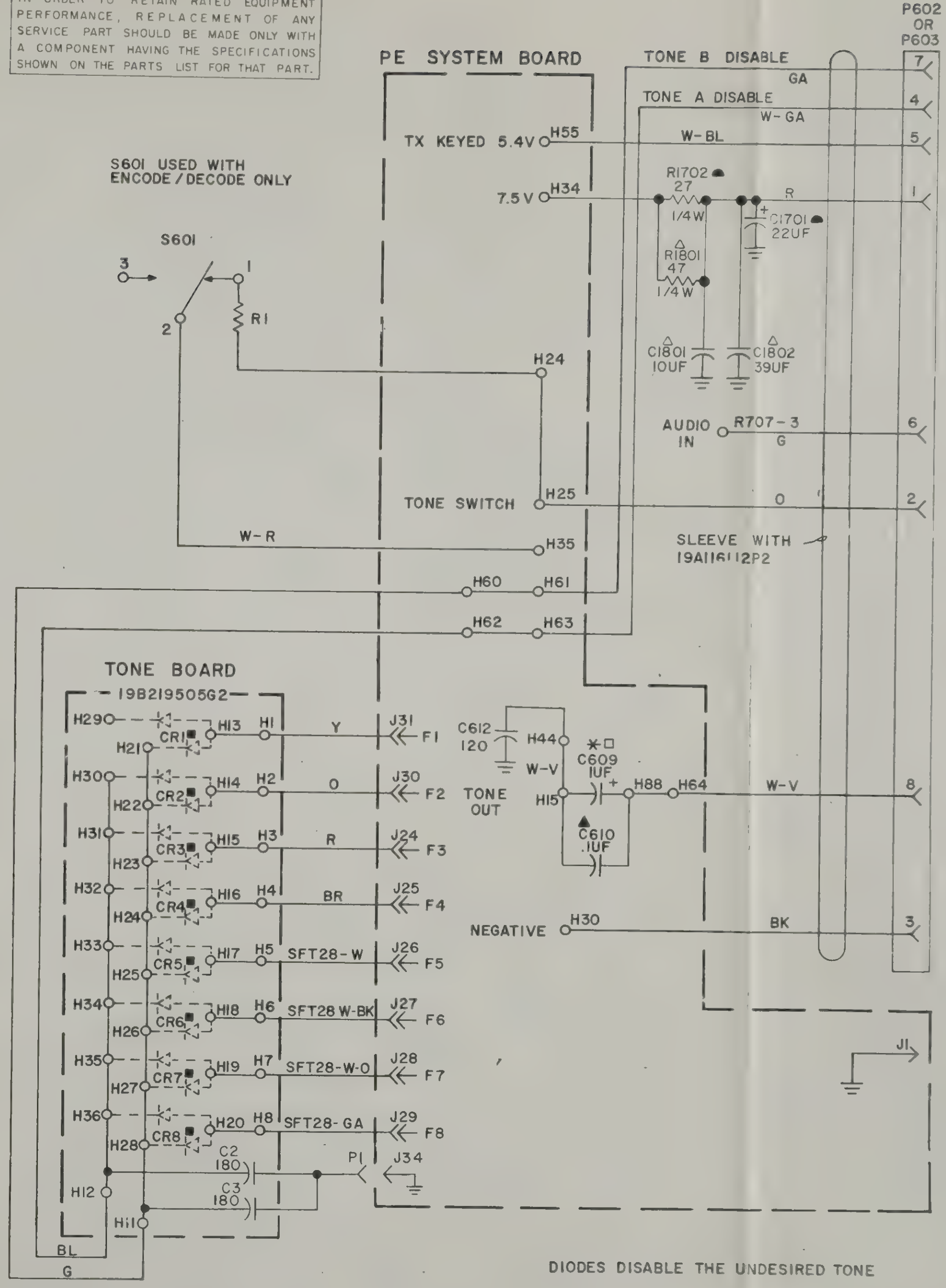

TONE BOARD
19B219505G1
H1
H2
H3
H4
H5
H6
H7
H8
H13
H14
H15
H16
H17
H18
H19
H20
H21
H22
H23
H24
H25
H26
H27
H28
H29
H30
H31
H32
H33
H34
H35
H36
H11
H10

REV. B - To improve RF filtering. Added C612.

REV. C - To improve RF filtering. Added R606, C611 and L601.

IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.

THIS ELEM DIAG APPLIES TO	
MODEL NO	REV LETTER
PL19A130285G4	C
PL19A130285G5	C
PL19A137882G1	


PE SYSTEM BOARD
S601 USED WITH ENCODE / DECODE ONLY
S601
3
1
2
R1
TX KEYED 5.4V
H55
7.5V
H34
H24
AUDIO IN
H25
TONE SWITCH
H35
W-R
H60
H61
H62
H63
TONE B DISABLE
GA
TONE A DISABLE
W-GA
W-BL
R1702
27
1/4W
R1801
47
1/4W
R
C1701
22UF
C1801
10UF
C1802
39UF
R707-3
G
O
SLEEVE WITH 19A116112P2
P602 OR P603
7
4
5
1
6
2
8
3
TONE BOARD
19B219505G2
H29
H21
H30
H22
H31
H23
H32
H24
H33
H25
H34
H26
H35
H27
H36
H28
H12
H11
CR1
CR2
CR3
CR4
CR5
CR6
CR7
CR8
H13
H14
H15
H16
H17
H18
H19
H20
H1
H2
H3
H4
H5
H6
H7
H8
Y
O
R
BR
SFT28-W
SFT28 W-BK
SFT28-W-O
SFT28-GA
J31
J30
J24
J25
J26
J27
J28
J29
F1
F2
F3
F4
F5
F6
F7
F8
C2
180
C3
180
P1
J34
C612
120
H44
W-V
TONE OUT
H15
C609
1UF
C610
.1UF
H88
H64
W-V
NEGATIVE
H30
BK
J1
BL
G

DIODES DISABLE THE UNDESIRED TONE

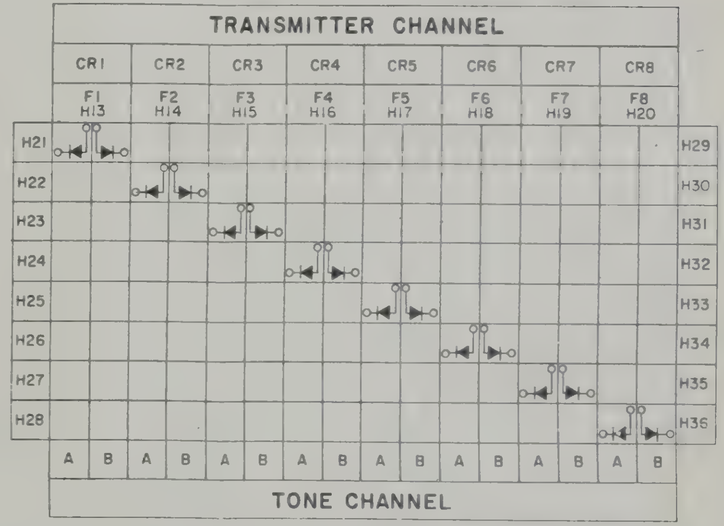
■ NOT PRESENT IN ENCODE/DECODE. (1 PART)
▲ NOT PRESENT IN LOW BAND (30-50 MHz), OR HIGH BAND PY (150-174 MHz) (1 PART)
☐ NOT PRESENT IN HI-BAND PE (132-174 MHz) (1 PART)
✱ NOT PRESENT IN 450 (406-512 MHz). (1 PART)
● USED ONLY WITH INTRINSICALLY SAFE RADIO
△ PRESENT ONLY WITH OPTION 4422 OR 4424 AND CHANNEL GUARD

NOTE:

ALL WIRES SFT # 28 UNLESS OTHERWISE SPECIFIED.

ALL RESISTORS ARE 1/8 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.

(19D417836, Rev. 8)


TRANSMITTER CHANNEL
CR1
CR2
CR3
CR4
CR5
CR6
CR7
CR8
F1 H13
F2 H14
F3 H15
F4 H16
F5 H17
F6 H18
F7 H19
F8 H20
H21
H22
H23
H24
H25
H26
H27
H28
H29
H30
H31
H32
H33
H34
H35
H36
A
B
TONE CHANNEL

USE THE ABOVE CHART FOR ASSEMBLING DIODES IN THE TWO TONE SELECTOR BOARD 19B219505G1 OR G2. THE DIODES DISABLES THE UNDESIRED TONE.

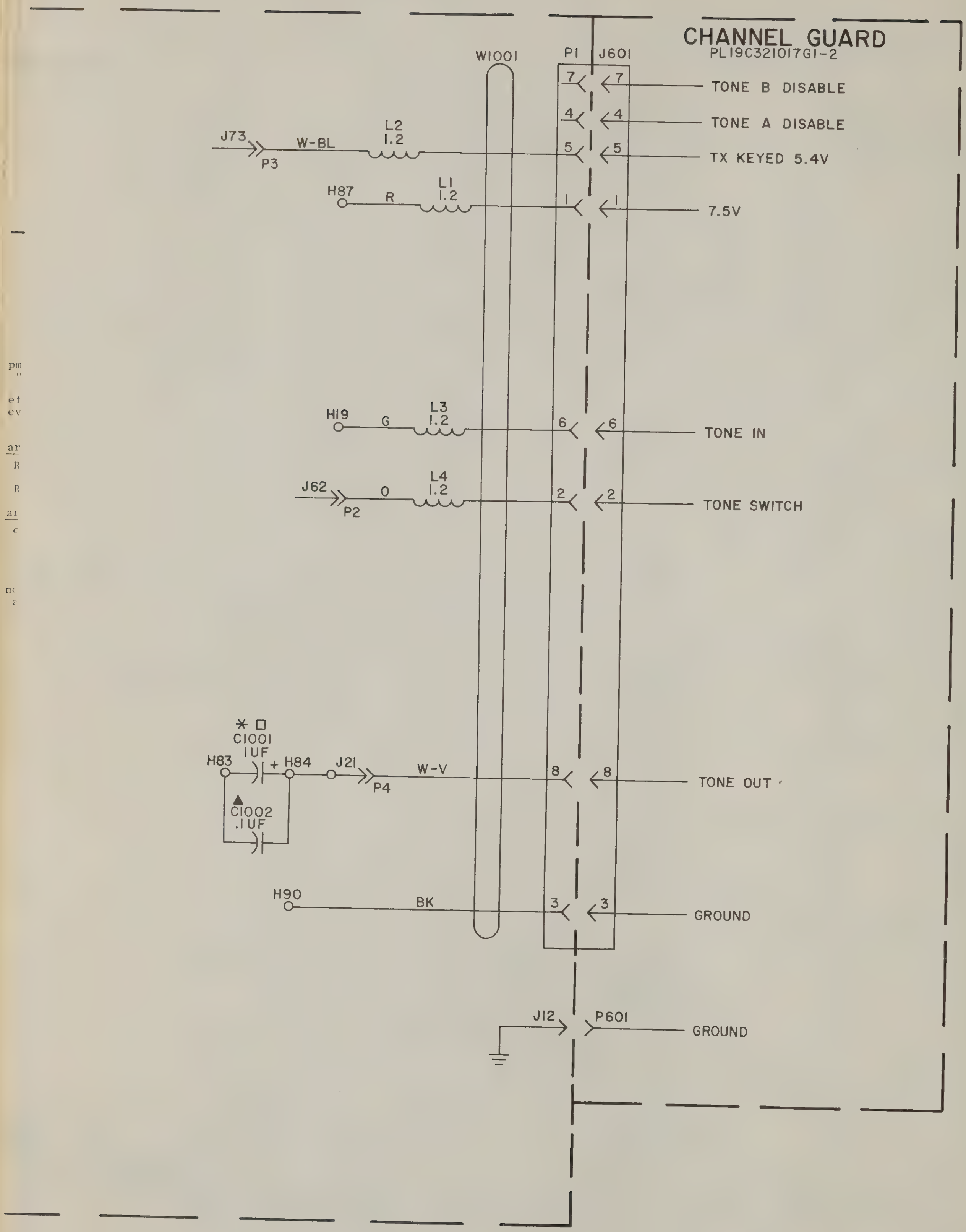
SAMPLE: 1 IF TONE B IS TO BE USED ON F3, THEN FIND F3 ON CHART. GO DOWN COLUMN UNTIL YOU FIND A DIODE. THE DIODE IN COLUMN B GIVES THE HOLE NUMBER AND DIRECTION THE DIODE SHOULD BE ASSEMBLED. DIODE IN SAMPLE IS CONNECTED FROM H15 TO H31

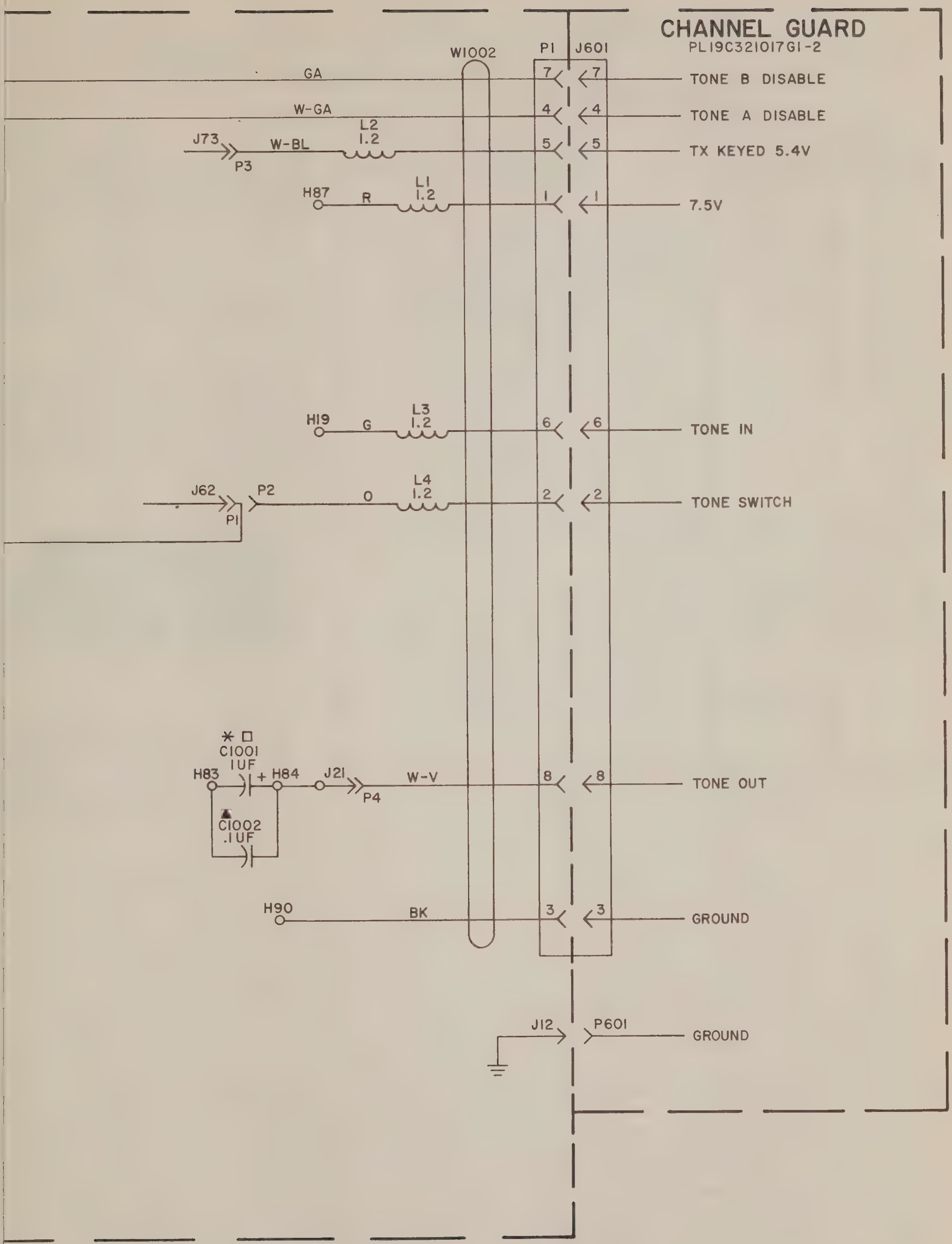
SAMPLE 2 IF F1 HAS NO TONES, THEN FIND F1 ON CHART GO DOWN COLUMN UNTIL YOU FIND A DIODE. THE DIODES IN COLUMN A & B GIVES THE HOLE NUMBER AND DIRECTION THE DIODES SHOULD BE ASSEMBLED TO GIVE YOU NO TONE. DIODES IN SAMPLE IS CONNECTED FROM H13 TO H21 AND H13 TO H29.

(19C321209, Rev. 0)

INTERCONNECTION DIAGRAM

EIGHT-FREQUENCY PE RADIO


CHANNEL GUARD
PL19C321017G1-2
W1001
P1
J601
7
TONE B DISABLE
4
TONE A DISABLE
J73
P3
W-BL
L2
1.2
5
TX KEYED 5.4V
H87
R
L1
1.2
1
7.5V
H19
G
L3
1.2
6
TONE IN
J62
P2
0
L4
1.2
2
TONE SWITCH
✱ □
C1001
1UF
H83
+
H84
J21
P4
W-V
8
TONE OUT
▲
C1002
.1UF
H90
BK
3
GROUND
J12
P601
GROUND


CHANNEL GUARD
PL19C321017G1-2
W1002
P1
J601
GA
W-GA
J73
P3
W-BL
L2
1.2
H87
R
L1
1.2
7
4
5
1
TONE B DISABLE
TONE A DISABLE
TX KEYED 5.4V
7.5V
H19
G
L3
1.2
6
TONE IN
J62
P2
P1
O
L4
1.2
2
TONE SWITCH
✱ □
C1001
1UF
H83
+
H84
J21
P4
W-V
▲
C1002
.1UF
8
TONE OUT
H90
BK
3
GROUND
J12
P601
GROUND

INTERCONNECTION DIAGRAM

TWO-TONE ENCODE DECODE
Porta ● Mobile II RADIO

PARTS LIST

LBI-30526

PM II CHANNEL GUARD MOD KIT
1 TONE ENCODE/DECODE
19A130977G1

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - CAPACITORS - - - - - - - -
C1001	5491674P1	Tantalum: 1.0 µf +40-20%, 10 VDCW; sim to Sprague Type 162D.
C1002	19A116192P14	Ceramic: .1 µf ±20%, 50 VDCW; sim to Erie USCC CW20C104-M2.
		- - - - - - - - - - SWITCHES - - - - - - - -
S1001	19B226809G12	Toggle: SPDT; sim to C and K Component 7107SDG.
		- - - - - - - - - - CABLES - - - - - - - -
W1001		CABLE, RELAY ASSEMBLY 19B226806G7
		- - - - - - - - - - INDUCTORS - - - - - - - -
L1 thru L4	19B209420P114	Coil, RF: 1.20 µh ±10%, 0.18 ohms DC res max; sim to Jeffers 4436-1.
		- - - - - - - - - - PLUGS - - - - - - - -
P1	19A127569G1	Plug: 8 contacts.
P2 thru P4	19A115834P4	Contact, electrical: sim to AMP 2-332070-9.
		- - - - - - - - - - MISCELLANEOUS - - - - - - - -
	19B227357G1	Insulator. (Used with Channel Guard Board).
	19C320975P1	Seal. (Used with S1001).
	19B226358G10	Faceplate (FOR S1001).

THIS ELEM DIAG APPLIES TO

MODEL NO	REV LETTER

IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.

ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG = 1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.

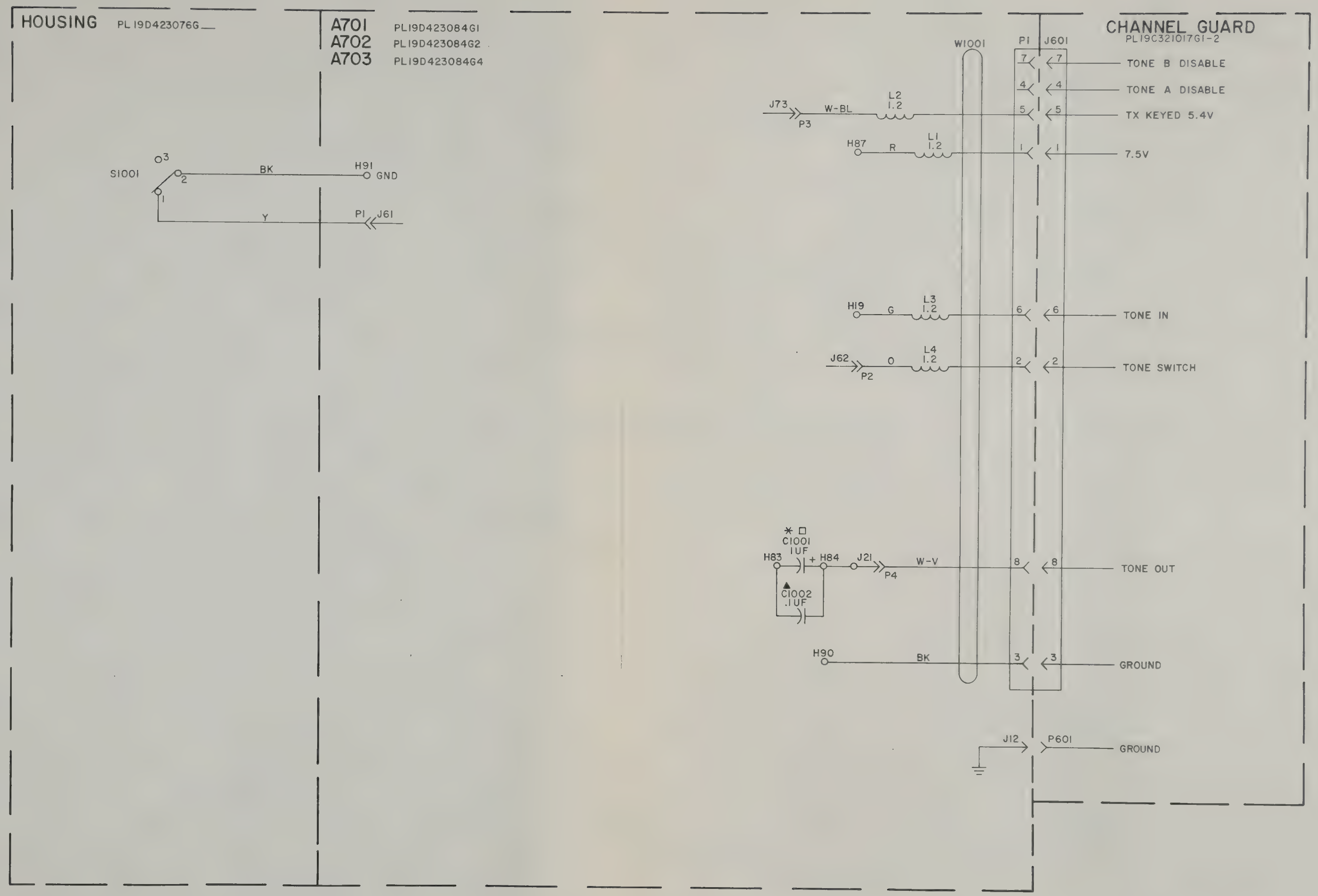
NOTE:

ALL WIRES T-28 UNLESS OTHERWISE SPECIFIED.

▲ NOT PRESENT IN LOW BAND (30-50 MHZ). (1 PART)

□ NOT PRESENT IN HI-BAND (132-174 MHz). (1 PART)

✳ NOT PRESENT IN 450 (406-512 MHz). (1 PART)


HOUSING PL19D423076G__
A701 PL19D423084G1
A702 PL19D423084G2
A703 PL19D423084G4
S1001
3
2
1
BK
H91
GND
Y
P1
J61
CHANNEL GUARD
PL19C321017G1-2
W1001
P1
J601
J73
P3
W-BL
L2
1.2
H87
R
L1
1.2
H19
G
L3
1.2
J62
P2
0
L4
1.2
7
4
5
1
6
2
8
3
TONE B DISABLE
TONE A DISABLE
TX KEYED 5.4V
7.5V
TONE IN
TONE SWITCH
✳ □
C1001
1UF
H83
+
H84
J21
P4
W-V
▲
C1002
.1UF
TONE OUT
H90
BK
GROUND
J12
P601
GROUND

(19D423943, Rev. 1)

INTERCONNECTION DIAGRAM

ONE-TONE ENCODE DECODE
Porta • Mobile II RADIO

Issue 2

PARTS LIST

LBI-30527

PM II CHANNEL GUARD MOD KIT
2 TONE ENCODER/DECODER
19A130977G2

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - - - CAPACITORS - - - - - - - - -
C1001	5491674P1	Tantalum: 1.0 µf +40-20%, 10 VDCW; sim to Sprague Type 162D.
C1002	19A116192P14	Ceramic: .1 µf ±20%, 50 VDCW; sim to Erie USCC CW20C104-M2.
		- - - - - - - - - - - - RESISTORS - - - - - - - - - -
R604 and R605	3R151P104K	Composition: 100,000 ohms ±10%, 1/8 w.
		- - - - - - - - - - - - SWITCHES - - - - - - - - - -
S1002		SWITCH ASSEMBLY 19B226809G13
		- - - - - - - - - DIODES AND RECTIFIERS - - - - - -
CR1 thru CR3	19A115250P1	Silicon.
		- - - - - - - - - - - - - PLUGS - - - - - - - - - - -
P1	19A115834P4	Contact, electrical: sim to AMP 2-332070-9.
		- - - - - - - - - - - SWITCHES - - - - - - - - - - -
	19A116648P2	Switch, toggle: DPDT; sim to C and K Components.
		- - - - - - - - - - - - - CABLES - - - - - - - - - -
W1002		CABLE, RELAY ASSEMBLY 19B226806G8
		- - - - - - - - - - - - INDUCTORS - - - - - - - - - -
L1 thru L4	19B209420P114	Coil, RF: 1.20 µh ±10%, 0.18 ohms DC res max; sim to Jeffers 4436-1.
		- - - - - - - - - - - - - PLUGS - - - - - - - - - - -
P1	19A127569G1	Plug: 8 contacts.
P2 thru P4	19A115834P4	Contact, electrical: sim to AMP 2-332070-9.
		- - - - - - - - - - - - SOCKETS - - - - - - - - - - -
XFL602		Socket. Includes shell and contacts. (Order separately).
	19D416714P1	Shell.
	19B219681P1	Contact, electrical. (Quantity 7).
		- - - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19B227357G1	Insulator. (Used with Channel Guard Board).
	19C320975P1	Seal. (Used with S1002).
	19B226358G9	Faceplate (For S1002).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

THIS ELEM DIAG APPLIES TO	
MODEL NO	REV LETTER

IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.

ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.

NOTE:

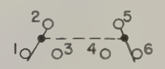
ALL WIRES T-28 UNLESS OTHERWISE SPECIFIED.

▲ NOT PRESENT IN LOW BAND (30-50 MHZ). (1 PART)

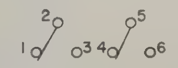
☐ NOT PRESENT IN HI-BAND (132-174 MHz). (1 PART)

✱ NOT PRESENT IN 450 (406-512 MHz). (1 PART)

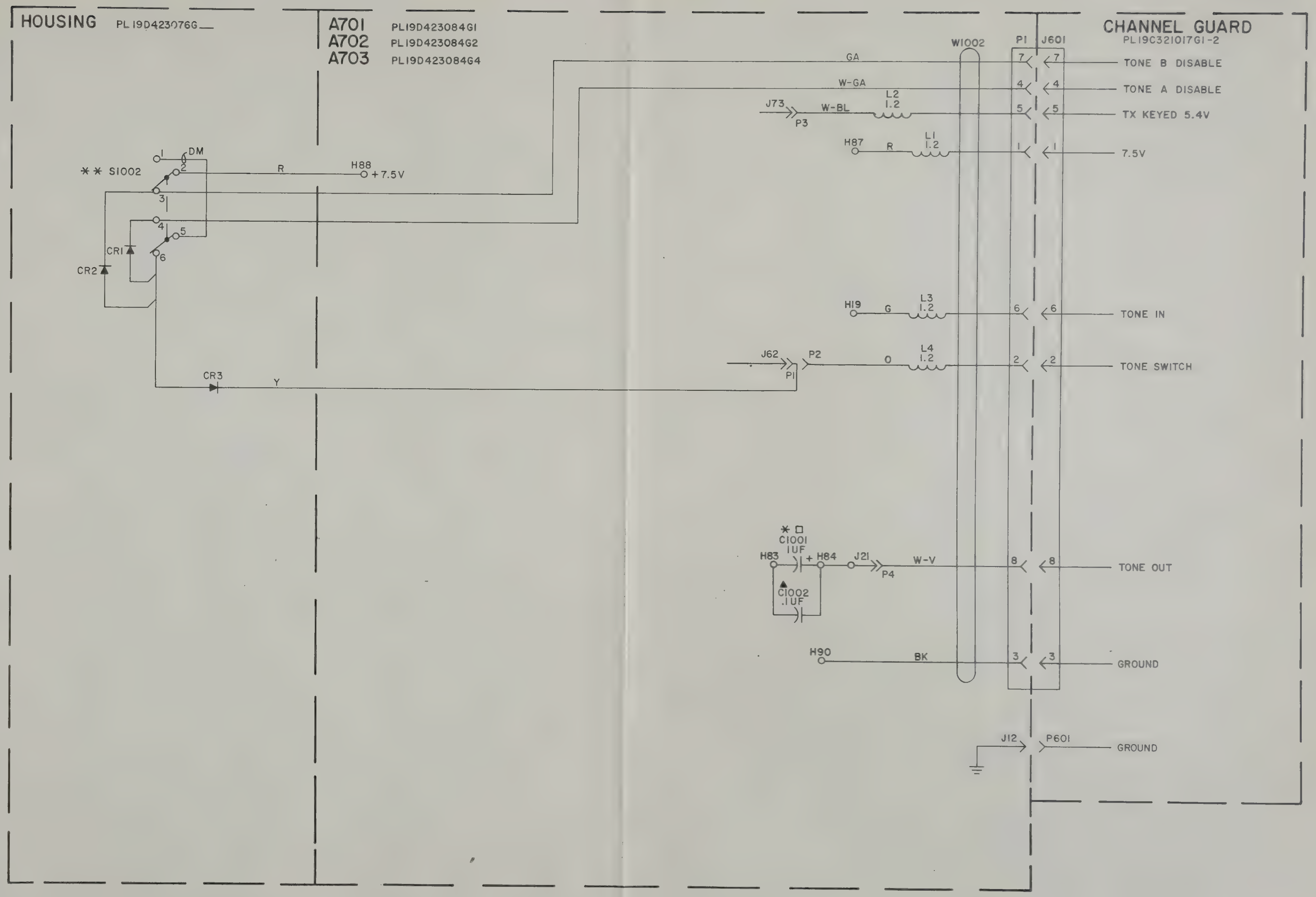
✱✱ S1002 SHOWN IN TONE "A" POSITION
(FOR OTHER POSITIONS SEE BELOW)



S1002 IN OFF POSITION



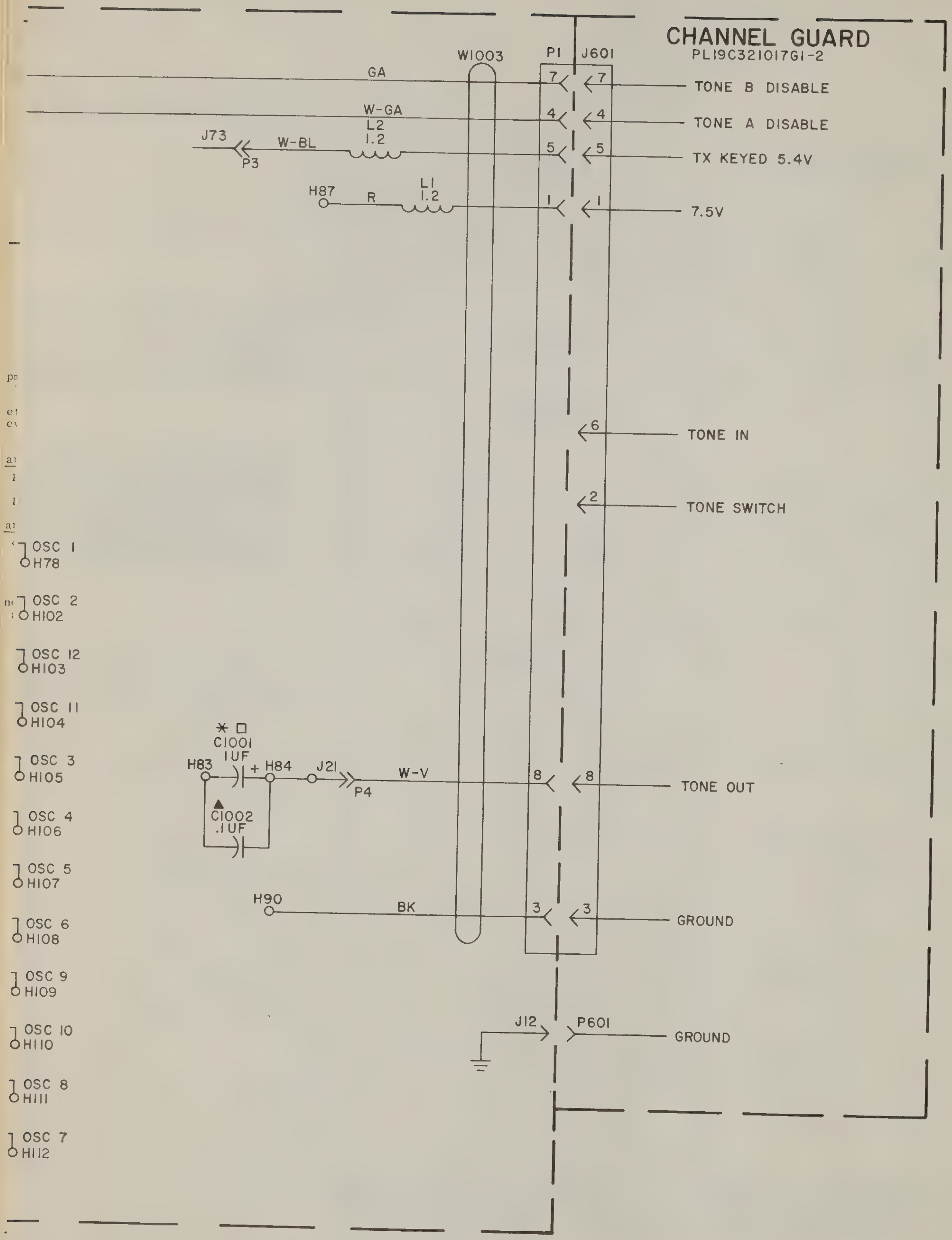
S1002 IN TONE "B" POSITION

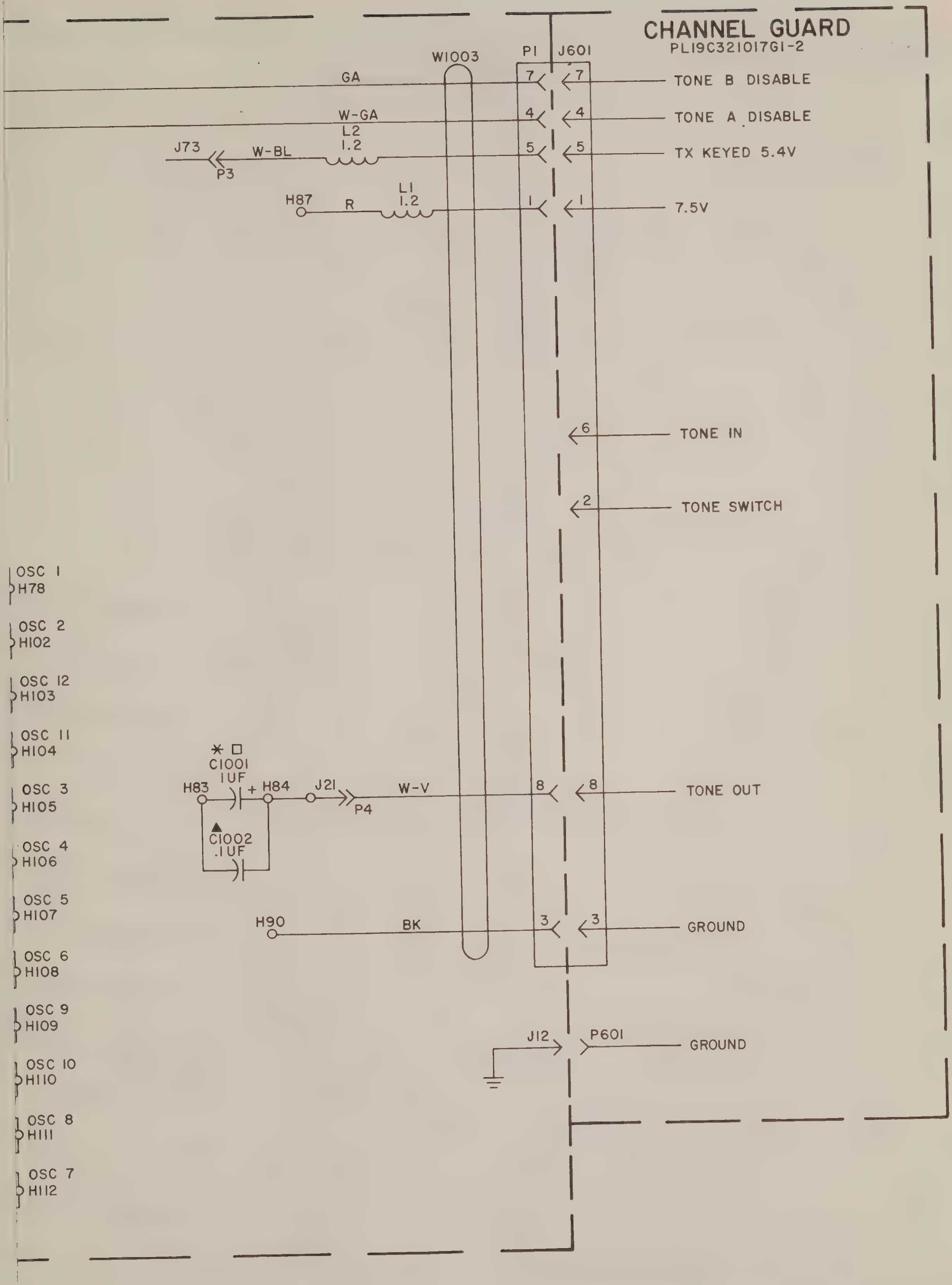

HOUSING PL19D423076G
A701 PL19D423084G1
A702 PL19D423084G2
A703 PL19D423084G4
CHANNEL GUARD PL19C321017G1-2
W1002
P1
J601
GA
W-GA
J73
P3
W-BL
L2 1.2
H87
R
L1 1.2
✱✱ S1002
DM
1
2
3
4
5
6
H88
+7.5V
CR1
CR2
H19
G
L3 1.2
J62
P2
P1
O
L4 1.2
CR3
Y
✱ ☐ C1001 1UF
H83
+
H84
J21
P4
W-V
▲ C1002 .1UF
H90
BK
J12
P601
TONE B DISABLE
TONE A DISABLE
TX KEYED 5.4V
7.5V
TONE IN
TONE SWITCH
TONE OUT
GROUND
GROUND
7
4
5
1
6
2
8
3

(19D423946, Rev. 2)

INTERCONNECTION DIAGRAM

TWO-TONE ENCODE DECODE
Porta • Mobile II RADIO


CHANNEL GUARD
PL19C321017G1-2
W1003
P1
J601
GA
W-GA
L2
1.2
J73
W-BL
P3
H87
R
L1
1.2
7
4
5
1
TONE B DISABLE
TONE A DISABLE
TX KEYED 5.4V
7.5V
6
TONE IN
2
TONE SWITCH
✱ □
C1001
1UF
H83
+
H84
J21
P4
W-V
8
TONE OUT
▲
C1002
.1UF
H90
BK
3
GROUND
J12
P601
GROUND
OSC 1
H78
OSC 2
H102
OSC 12
H103
OSC 11
H104
OSC 3
H105
OSC 4
H106
OSC 5
H107
OSC 6
H108
OSC 9
H109
OSC 10
H110
OSC 8
H111
OSC 7
H112


CHANNEL GUARD
PL19C321017G1-2
W1003
P1
J601
GA
W-GA
L2
1.2
J73
W-BL
P3
H87
R
L1
1.2
TONE B DISABLE
TONE A DISABLE
TX KEYED 5.4V
7.5V
TONE IN
TONE SWITCH
OSC 1
H78
OSC 2
H102
OSC 12
H103
OSC 11
H104
OSC 3
H105
OSC 4
H106
OSC 5
H107
OSC 6
H108
OSC 9
H109
OSC 10
H110
OSC 8
H111
OSC 7
H112
C1001
1UF
H83
H84
J21
P4
W-V
C1002
.1UF
TONE OUT
H90
BK
GROUND
J12
P601
GROUND

1)

INTERCONNECTION DIAGRAM

TWO-TONE ENCODE
AUTOMATIC TONE SELECT
Porta ● Mobile II RADIO

PARTS LIST

LBI-30532

PM II CHANNEL GUARD MOD KIT
1 TONE ENCODER W AUTO SELECT
19A130977G7

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - - CAPACITORS - - - - - - - -
C1001	5491674P1	Tantalum: 1.0 µf +40-20%, 10 VDCW; sim to Sprague Type 162D.
C1002	19A116192P14	Ceramic: .1 µf ±20%, 50 VDCW; sim to Erie USCC CW20C104-M2.
		- - - - - - - DIODES AND RECTIFIERS - - - - - -
CR1025 thru CR1036	19A115100P1	Silicon; sim to Type 1N458A.
		- - - - - - - - - - RESISTORS - - - - - - - - -
R604	3R151P104K	Composition: 100,000 ohms ±10%, 1/8 w.
		- - - - - - - - - - - - CABLES - - - - - - - - -
W1003		CABLE, RELAY ASSEMBLY 19B226806G9
		- - - - - - - - - - - INDUCTORS - - - - - - - - -
L1 and L2	19B209420P114	Coil, RF: 1.20 µh ±10%, 0.18 ohms DC res max; sim to Jeffers 4436-1.
		- - - - - - - - - - - - PLUGS - - - - - - - - - -
P1	19A127569G1	Plug: 8 contacts.
P2 thru P4	19A115834P4	Contact, electrical: sim to AMP 2-332070-9.
		- - - - - - - - - - MISCELLANEOUS - - - - - - - -
	19B227357G1	Insulator. (Used with Channel Guard Board).

THIS ELEM DIAG APPLIES TO	
MODEL NO	REV LETTER

IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART

ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF=MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH=MILLIHENRYS OR H=HENRYS.

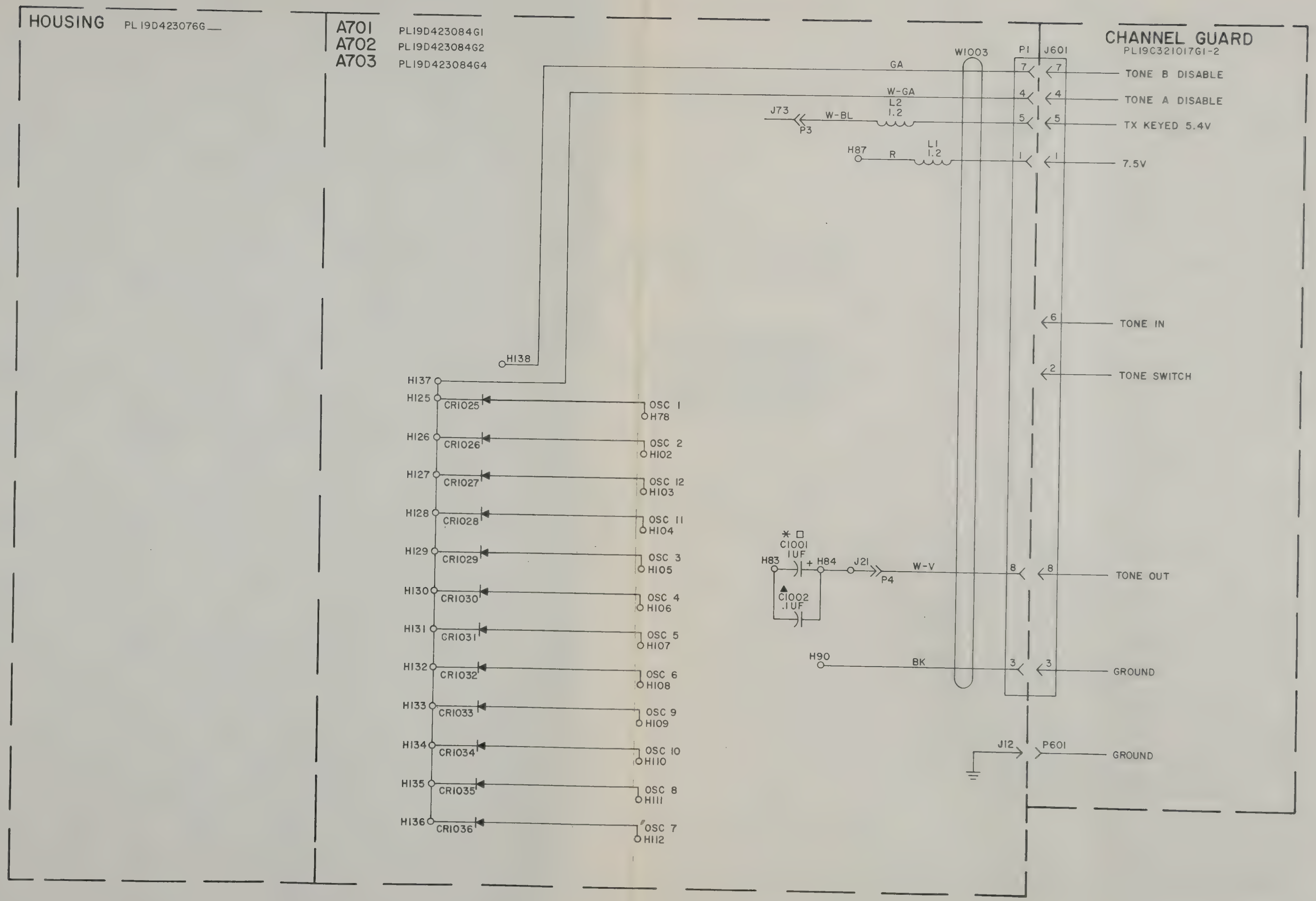
NOTE:

ALL WIRES T-28 UNLESS OTHERWISE SPECIFIED.

▲ NOT PRESENT IN LOW BAND (30-50 MHZ). (1 PART)

□ NOT PRESENT IN HI-BAND (132-174 MHz). (1 PART)

✱ NOT PRESENT IN 450 (406-512 MHz). (1 PART)


HOUSING PL19D423076G
A701 PL19D423084G1
A702 PL19D423084G2
A703 PL19D423084G4
CHANNEL GUARD PL19C321017G1-2
W1003
P1
J601
GA
W-GA
L2 1.2
J73
P3
W-BL
H87
R
L1 1.2
7
4
5
1
6
2
8
3
TONE B DISABLE
TONE A DISABLE
TX KEYED 5.4V
7.5V
TONE IN
TONE SWITCH
H138
H137
H125 CR1025 OSC 1 H78
H126 CR1026 OSC 2 H102
H127 CR1027 OSC 12 H103
H128 CR1028 OSC 11 H104
H129 CR1029 OSC 3 H105
H130 CR1030 OSC 4 H106
H131 CR1031 OSC 5 H107
H132 CR1032 OSC 6 H108
H133 CR1033 OSC 9 H109
H134 CR1034 OSC 10 H110
H135 CR1035 OSC 8 H111
H136 CR1036 OSC 7 H112
✱ □ C1001 1UF
H83
H84
J21
P4
W-V
▲ C1002 .1UF
TONE OUT
H90
BK
GROUND
J12
P601
GROUND

(19D423960, Rev. 1)

INTERCONNECTION DIAGRAM

ONE-TONE ENCODE AUTOMATIC TONE SELECT
Porta ● Mobile II RADIO

PARTS LIST

LBI-30533

PM II CHANNEL GUARD MOD KIT
2 TONE ENCODER W AUTO SELECT
19A130977G6

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - CAPACITORS - - - - - - - -
C1001	5491674P1	Tantalum: 1.0 µf +40-20%, 10 VDCW; sim to Sprague Type 162D.
C1002	19A116192P14	Ceramic: .1 µf ±20%, 50 VDCW; sim to Erie USCC CW20C104-M2.
		- - - - - - - DIODES AND RECTIFIERS - - - - - -
CR1013 thru CR1036	19A115100P1	Silicon; sim to Type 1N458A.
		- - - - - - - - - - RESISTORS - - - - - - - - -
R604 and R605	3R151P104K	Composition: 100,000 ohms ±10%, 1/8 w.
		- - - - - - - - - - - CABLES - - - - - - - - -
W1003		CABLE, RELAY ASSEMBLY 19B226806G9
		- - - - - - - - - - INDUCTORS - - - - - - - - -
L1 and L2	19B209420P114	Coil, RF: 1.20 µh ±10%, 0.18 ohms DC res max; sim to Jeffers 4436-1.
		- - - - - - - - - - - PLUGS - - - - - - - - - -
P1	19A127569G1	Plug: 8 contacts.
P2 thru P4	19A115834P4	Contact, electrical: sim to AMP 2-332070-9.
		- - - - - - - - - - SOCKETS - - - - - - - - - -
XFL602		Socket. Includes shell and contacts. (Order separately).
	19D416714P1	Shell.
	19B219681P1	Contact, electrical. (Quantity 7).
		- - - - - - - - - MISCELLANEOUS - - - - - - - -
	19B227357G1	Insulator. (Used with Channel Guard Board).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

THIS ELEM DIAG APPLIES TO	
MODEL NO	REV LETTER

IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.

ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF=MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH=MILLIHENRYS OR H=HENRYS.

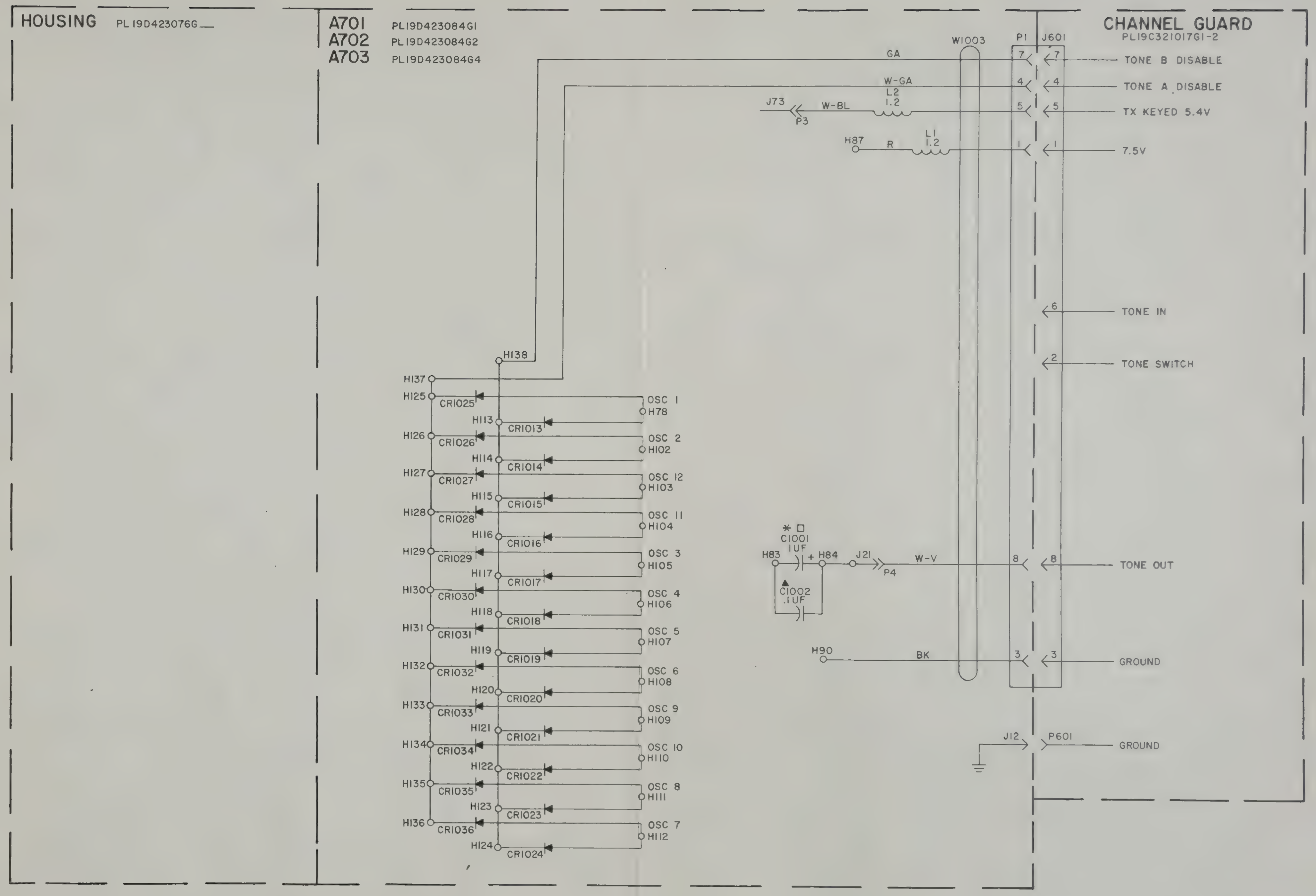
NOTE:

ALL WIRES T-28 UNLESS OTHERWISE SPECIFIED.

▲ NOT PRESENT IN LOW BAND (30-50 MHZ). (1 PART)

☐ NOT PRESENT IN HI-BAND (132-174 MHz). (1 PART)

✱ NOT PRESENT IN 450 (406-512 MHz). (1 PART)

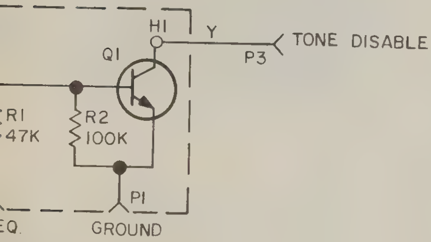

HOUSING
PL19D423076G
A701 PL19D423084G1
A702 PL19D423084G2
A703 PL19D423084G4
CHANNEL GUARD
PL19C321017G1-2
W1003
P1
J601
GA
W-GA
L2
1.2
J73
W-BL
P3
H87
R
L1
1.2
7
4
5
1
6
2
8
3
TONE B DISABLE
TONE A DISABLE
TX KEYED 5.4V
7.5V
TONE IN
TONE SWITCH
TONE OUT
GROUND
GROUND
H138
H137
H125
CR1025
H113
CR1013
OSC 1
H78
H126
CR1026
H114
CR1014
OSC 2
H102
H127
CR1027
H115
CR1015
OSC 12
H103
H128
CR1028
H116
CR1016
OSC 11
H104
H129
CR1029
H117
CR1017
OSC 3
H105
H130
CR1030
H118
CR1018
OSC 4
H106
H131
CR1031
H119
CR1019
OSC 5
H107
H132
CR1032
H120
CR1020
OSC 6
H108
H133
CR1033
H121
CR1021
OSC 9
H109
H134
CR1034
H122
CR1022
OSC 10
H110
H135
CR1035
H123
CR1023
OSC 8
H111
H136
CR1036
H124
CR1024
OSC 7
H112
✱ ☐
C1001
1UF
H83
+
H84
J21
P4
W-V
▲
C1002
.1UF
H90
BK
J12
P601

(19D423958, Rev. 1)

INTERCONNECTION DIAGRAM

TWO-TONE ENCODE
AUTOMATIC TONE SELECT
Porta ● Mobile II RADIO

AUTOMATIC MONITOR
19B226856



EQ.
DIODES

SISTORS ARE 1/4 WATT UNLESS
WISE SPECIFIED AND RESISTOR
IN OHMS UNLESS FOLLOWED BY
OHMS OR MEG = 1,000,000 OHMS.
TOR VALUES IN PICOFARADS (EQUAL
ROMICROFARADS) UNLESS FOLLOWED
MICROFARADS. INDUCTANCE VALUES
OHENRYS UNLESS FOLLOWED BY
LIHENRYS OR H = HENRYS.

DER TO RETAIN RATED EQUIPMENT
RMANCE, REPLACEMENT OF ANY
E PART SHOULD BE MADE ONLY WITH
PONENT HAVING THE SPECIFICATIONS
ON THE PARTS LIST FOR THAT PART.

(19B227361, Rev.1)

EMATIC DIAGRAM

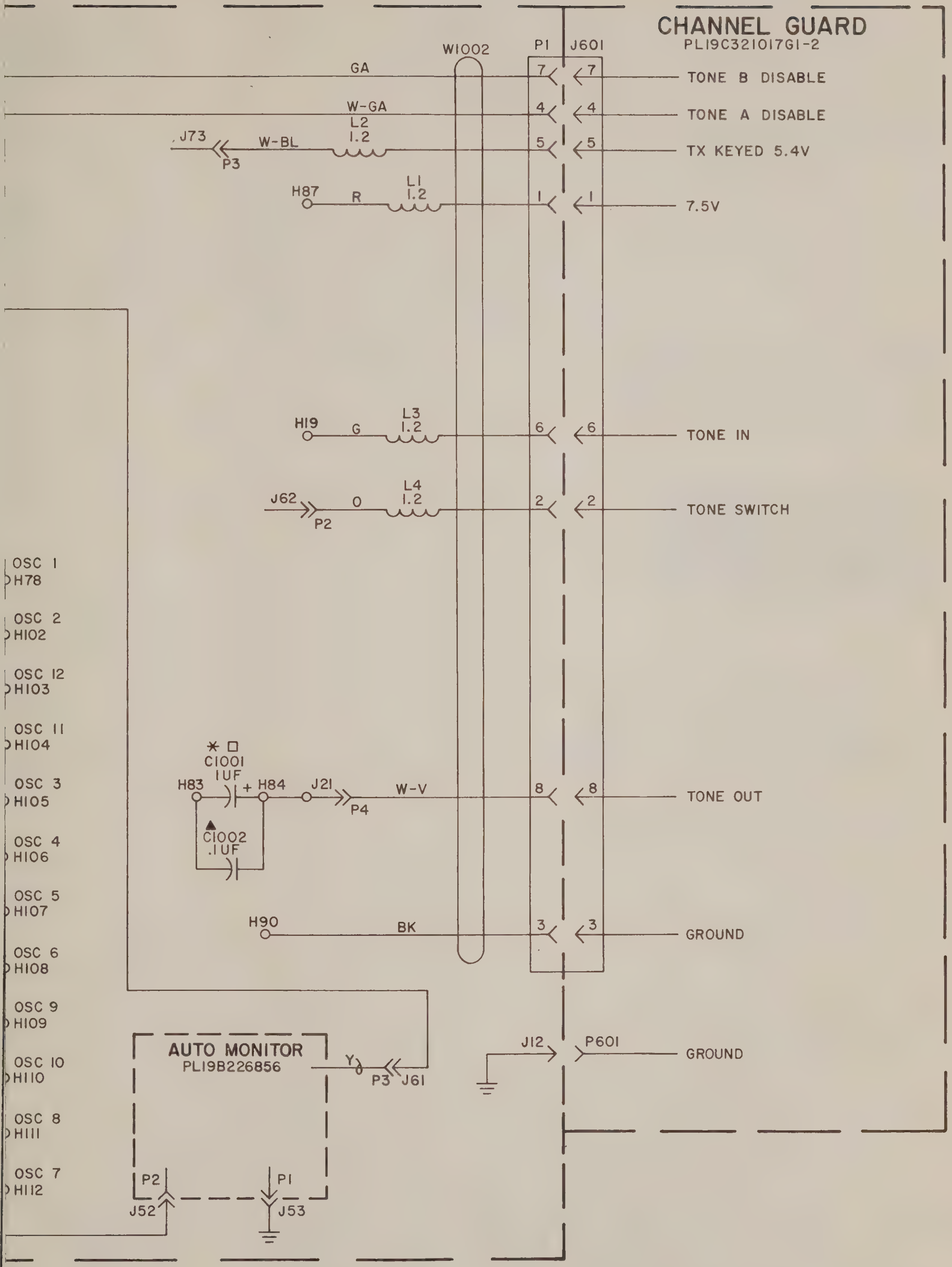
PARTS LIST

LBI30528A

PM II CHANNEL GUARD MOD KIT
1 TONE ENCODE/DECODE W AUTO MONITOR
19A130977G3

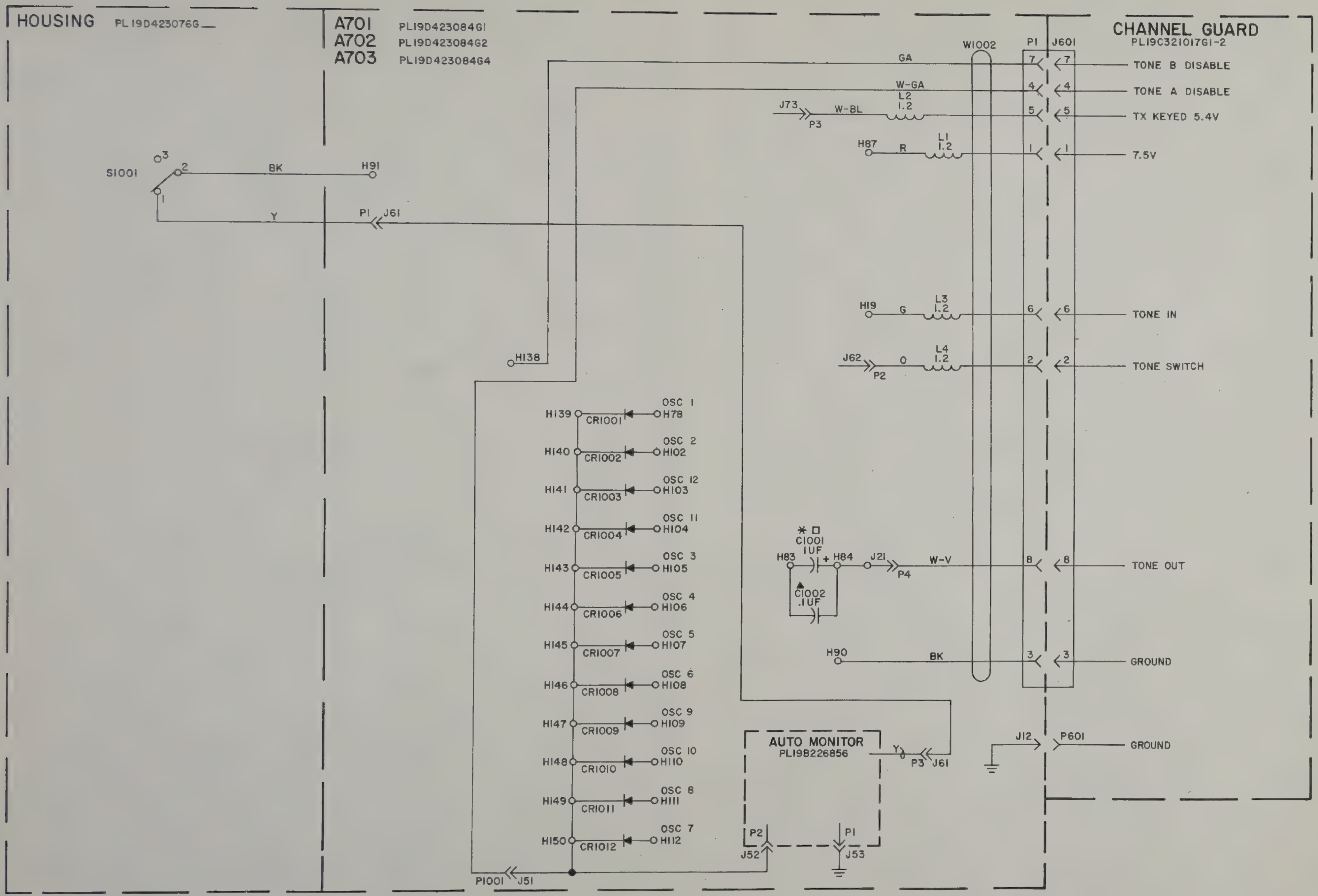
SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - - CAPACITORS - - - - - - - -
C1001	5491674P1	Tantalum: 1.0 µf +40-20%, 10 VDCW; sim to Sprague Type 162D.
C1002	19A116192P14	Ceramic: .1 µf ±20%, 50 VDCW; sim to Erie USCC CW20C104-M2.
		- - - - - - - - DIODES AND RECTIFIERS - - - - -
CR1001 thru CR1012	19A115100P1	Silicon; sim to Type 1N458A.
		- - - - - - - - - - - - PLUGS - - - - - - - - - -
P1001	19A115834P4	Contact, electrical: sim to AMP 2-332070-9.
		- - - - - - - - - - - RESISTORS - - - - - - - - -
R604	3R151P104K	Composition: 100K ohms ±10%, 1/8 w.
		- - - - - - - - - - - SWITCHES - - - - - - - - -
S1001	19B226809G12	Toggle: SPDT; sim to C and K Component 7107SDG.
		- - - - - - - - - - - CABLES - - - - - - - - - -
W1002		CABLE, RELAY ASSEMBLY 19B226806G8
		- - - - - - - - - - - INDUCTORS - - - - - - - - -
L1 thru L4	19B209420P114	Coil, RF: 1.20 µh ±10%, 0.18 ohms DC res max; sim to Jeffers 4436-1K.
		- - - - - - - - - - - PLUGS - - - - - - - - - -
P1	19A127569G1	Plug: 8 contacts.
P2 thru P4	19A115834P4	Contact, electrical: sim to AMP 2-332070-9.
		- - - - - - - - - MISCELLANEOUS - - - - - - - -
	19B227357G1	Insulator. (Used with Channel Guard Board).
	19C320975P1	Seal. (Used with S1001).
	19B226358G10	Faceplate. (For S1001).
		ASSOCIATED ASSEMBLIES
		AUTOMATIC MONITOR 19B226856G1
		- - - - - - - - - - - PLUGS - - - - - - - - - -
P1 thru P3	19A115834P4	Contact, electrical: sim to AMP 2-332070-9.
		- - - - - - - - - - - TRANSISTORS - - - - - - - -
Q1	19A129184P1	Silicon, NPN.
		- - - - - - - - - - - RESISTORS - - - - - - - - -
R1	3R152P473K	Composition: 47K ohms ±10%, 1/4 w.
R2	3R152P104K	Composition: 100K ohms ±10%, 1/4 w.
		- - - - - - - - - - - MISCELLANEOUS - - - - - - - -
	4035306P11	Insulator, fiber. (Used with Q1).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES


CHANNEL GUARD
PL19C321017G1-2
W1002
P1
J601
GA
TONE B DISABLE
W-GA
TONE A DISABLE
J73
W-BL
L2
1.2
P3
TX KEYED 5.4V
H87
R
L1
1.2
7.5V
H19
G
L3
1.2
TONE IN
J62
O
L4
1.2
P2
TONE SWITCH
OSC 1
H78
OSC 2
H102
OSC 12
H103
OSC 11
H104
OSC 3
H105
OSC 4
H106
OSC 5
H107
OSC 6
H108
OSC 9
H109
OSC 10
H110
OSC 8
H111
OSC 7
H112
✱ □
C1001
1UF
H83
+
H84
J21
P4
W-V
▲
C1002
.1UF
TONE OUT
H90
BK
GROUND
AUTO MONITOR
PL19B226856
Y
P3
J61
J12
P601
GROUND
P2
J52
P1
J53

INTERCONNECTION DIAGRAM

TWO-TONE ENCODE DECODE
AUTOMATIC MONITOR
Porta ● Mobile II RADIO

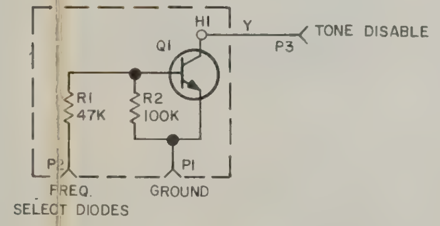

HOUSING PL19D423076G
A701 PL19D423084G1
A702 PL19D423084G2
A703 PL19D423084G4
CHANNEL GUARD
PL19C321017G1-2
S1001
1
2
3
BK
H91
Y
P1
J61
H138
GA
W-GA
J73
P3
W-BL
L2 1.2
H87
R
L1 1.2
W1002
P1
J601
7
4
5
1
TONE B DISABLE
TONE A DISABLE
TX KEYED 5.4V
7.5V
H19
G
L3 1.2
6
TONE IN
J62
P2
O
L4 1.2
2
TONE SWITCH
H139
CR1001
OSC 1
H78
H140
CR1002
OSC 2
H102
H141
CR1003
OSC 12
H103
H142
CR1004
OSC 11
H104
H143
CR1005
OSC 3
H105
H144
CR1006
OSC 4
H106
H145
CR1007
OSC 5
H107
H146
CR1008
OSC 6
H108
H147
CR1009
OSC 9
H109
H148
CR1010
OSC 10
H110
H149
CR1011
OSC 8
H111
H150
CR1012
OSC 7
H112
✱ □
C1001
1UF
H83
+
H84
J21
P4
W-V
▲
C1002
.1UF
8
TONE OUT
H90
BK
3
GROUND
AUTO MONITOR
PL19B226856
Y
P3
J61
J12
P601
GROUND
P2
J52
P1
J53
P1001
J51

INTERCONNECTION DIAGRAM

ONE-TONE ENCODE DECODE
AUTOMATIC MONITOR
Porta ● Mobile II RADIO

(19D423951, Rev. 1)

AUTOMATIC MONITOR
19B226856


H1
Y
Q1
P3
TONE DISABLE
R1
47K
R2
100K
P2
P1
FREQ.
SELECT DIODES
GROUND

ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG = 1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H= HENRYS.

IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART

(19B227361, Rev.1)

SCHEMATIC DIAGRAM

PARTS LIST

LBI30528A

PM II CHANNEL GUARD MOD KIT
1 TONE ENCODE/DECODE W AUTO MONITOR
19A130977G3

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - - CAPACITORS - - - - - - - - -
C1001	5491674P1	Tantalum: 1.0 µf +40-20%, 10 VDCW; sim to Sprague Type 162D.
C1002	19A116192P14	Ceramic: .1 µf ±20%, 50 VDCW; sim to Erie USCC CW20C104-M2.
		- - - - - - - - - DIODES AND RECTIFIERS - - - - -
CR1001 thru CR1012	19A115100P1	Silicon; sim to Type 1N458A.
		- - - - - - - - - - - - PLUGS - - - - - - - - - - -
P1001	19A115834P4	Contact, electrical: sim to AMP 2-332070-9.
		- - - - - - - - - - - RESISTORS - - - - - - - - - -
R604	3R151P104K	Composition: 100K ohms ±10%, 1/8 w.
		- - - - - - - - - - - SWITCHES - - - - - - - - - -
S1001	19B226809G12	Toggle: SPDT; sim to C and K Component 7107SDG.
		- - - - - - - - - - - CABLES - - - - - - - - - - -
W1002		CABLE, RELAY ASSEMBLY 19B226806G8
		- - - - - - - - - - - INDUCTORS - - - - - - - - - -
L1 thru L4	19B209420P114	Coil, RF: 1.20 µh ±10%, 0.18 ohms DC res max: sim to Jeffers 4436-1K.
		- - - - - - - - - - - - PLUGS - - - - - - - - - - -
P1	19A127569G1	Plug: 8 contacts.
P2 thru P4	19A115834P4	Contact, electrical: sim to AMP 2-332070-9.
		- - - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19B227357G1	Insulator. (Used with Channel Guard Board).
	19C320975P1	Seal. (Used with S1001).
	19B226358G10	Faceplate. (For S1001).
		ASSOCIATED ASSEMBLIES
		AUTOMATIC MONITOR 19B226856G1
		- - - - - - - - - - - - PLUGS - - - - - - - - - - - -
P1 thru P3	19A115834P4	Contact, electrical: sim to AMP 2-332070-9.
		- - - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q1	19A129184P1	Silicon, NPN.
		- - - - - - - - - - - RESISTORS - - - - - - - - - - -
R1	3R152P473K	Composition: 47K ohms ±10%, 1/4 w.
R2	3R152P104K	Composition: 100K ohms ±10%, 1/4 w.
		- - - - - - - - - - - MISCELLANEOUS - - - - - - - - -
	4035306P11	Insulator, fiber. (Used with Q1).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

PARTS LIST

LBI30529A

PM II CHANNEL GUARD MOD KIT
2 TONE ENCODE/DECODE W AUTO MONITOR
19A130977G4

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - - CAPACITORS - - - - - - - - -
C1001	5491674P1	Tantalum: 1.0 µf +40-20%, 10 VDCW; sim to Sprague Type 162D.
C1002	19A116192P14	Ceramic: .1 µf ±20%, 50 VDCW; sim to Erie USCC CW20C104-M2.
		- - - - - - - - - DIODES AND RECTIFIERS - - - - -
CR1001 thru CR1036	19A115100P1	Silicon; sim to Type 1N458A.
		- - - - - - - - - - - RESISTORS - - - - - - - - - -
R604 and R605	3R151P104K	Composition: 100K ohms ±10%, 1/8 w.
		- - - - - - - - - - - SWITCHES - - - - - - - - - -
S1001	19B226809G12	Toggle: SPDT; sim to C and K Component 7107SDG.
		- - - - - - - - - - - CABLES - - - - - - - - - - -
W1002		CABLE, RELAY ASSEMBLY 19B226806G8
		- - - - - - - - - - - INDUCTORS - - - - - - - - - -
L1 thru L4	19B209420P114	Coil, RF: 1.20 µh ±10%, 0.18 ohms DC res max; sim to Jeffers 4436-1K.
		- - - - - - - - - - - - PLUGS - - - - - - - - - -
P1	19A127569G1	Plug: 8 contacts.
P2 thru P4	19A115834P4	Contact, electrical: sim to AMP 2-32070-9.
		- - - - - - - - - - - SOCKETS - - - - - - - - - - -
XFL602		Socket. Includes shell and contacts. (Order separately).
	19D416714P1	Shell.
	19B219681P1	Contact, electrical. (Quantity 7).
		- - - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19B227357G1	Insulator. (Used with Channel Guard Board).
	19C320975P1	Seal. (Used with S1001).
	19B226358G10	Faceplate. (For S1001).
		ASSOCIATED ASSEMBLIES
		AUTOMATIC MONITOR 19B226856G1
		- - - - - - - - - - - - PLUGS - - - - - - - - - - -
P1 thru P3	19A115834P4	Contact, electrical: sim to AMP 2-332070-9.
		- - - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q1	19A129184P1	Silicon, NPN.
		- - - - - - - - - - - RESISTORS - - - - - - - - - - -
R1	3R152P473K	Composition: 47K ohms ±10%, 1/4 w.
R2	3R152P104K	Composition: 100K ohms ±10%, 1/4 w.
		- - - - - - - - - - MISCELLANEOUS - - - - - - - - -
	4035306P11	Insulator, fiber. (Used with Q1).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

THIS ELEM DIAG APPLIES TO	
MODEL NO	REV LETTER

IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.

ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.

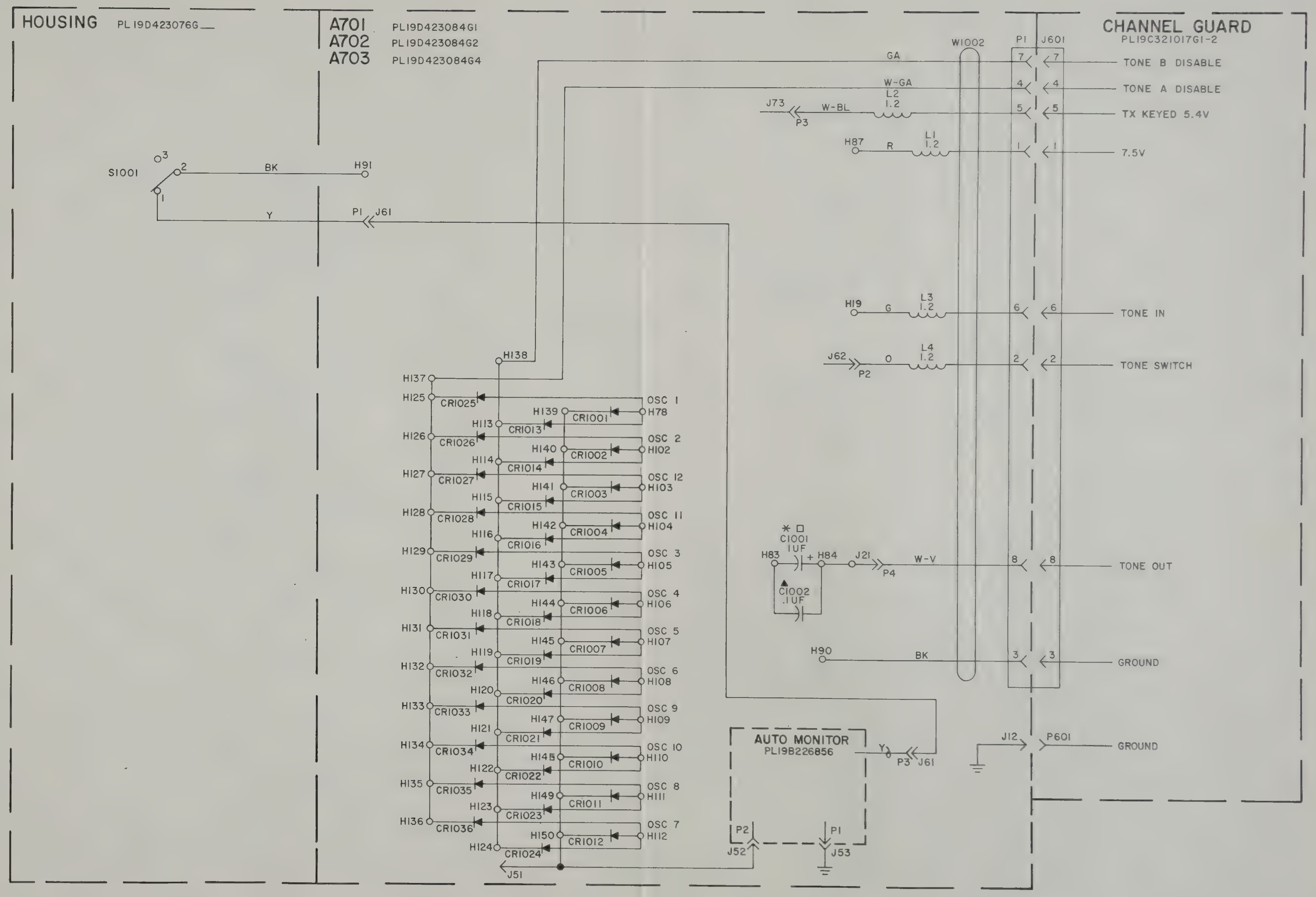
NOTE:

ALL WIRES T-28 UNLESS OTHERWISE SPECIFIED.

▲ NOT PRESENT IN LOW BAND (30-50 MHZ). (1 PART)

☐ NOT PRESENT IN HI-BAND (132-174 MHz). (1 PART)

✱ NOT PRESENT IN 450 (406-512 MHz). (1 PART)

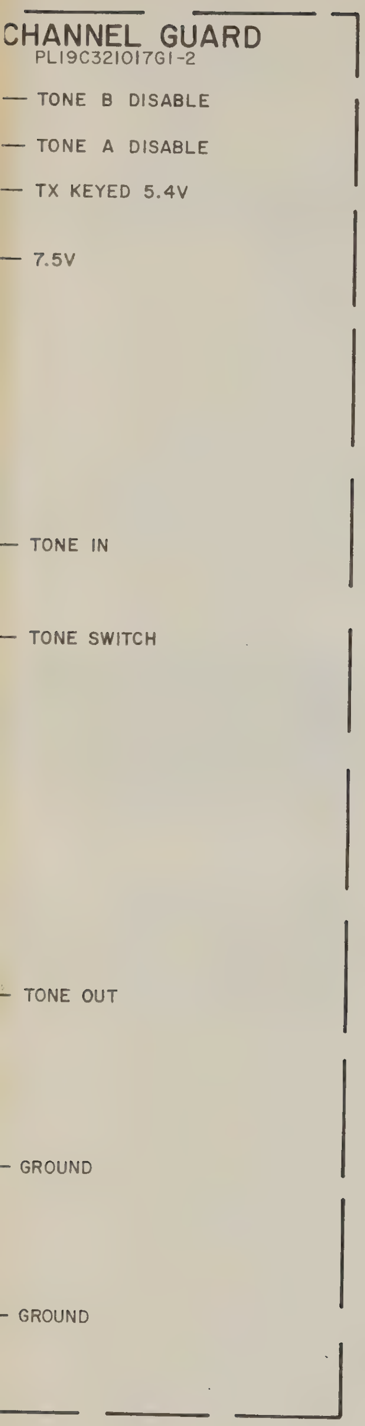

HOUSING PL19D423076G__
A701 PL19D423084G1
A702 PL19D423084G2
A703 PL19D423084G4
CHANNEL GUARD PL19C321017G1-2
S1001
3
2
1
BK
H91
Y
P1
J61
W1002
P1
J601
GA
W-GA
L2 1.2
J73
P3
W-BL
H87
R
L1 1.2
H19
G
L3 1.2
J62
P2
O
L4 1.2
7
4
5
1
6
2
8
3
TONE B DISABLE
TONE A DISABLE
TX KEYED 5.4V
7.5V
TONE IN
TONE SWITCH
TONE OUT
GROUND
GROUND
H138
H137
H125
CR1025
OSC 1
H139
CR1001
H78
H113
CR1013
H126
CR1026
OSC 2
H140
CR1002
H102
H114
CR1014
H127
CR1027
OSC 12
H141
CR1003
H103
H115
CR1015
H128
CR1028
OSC 11
H142
CR1004
H104
H116
CR1016
H129
CR1029
OSC 3
H143
CR1005
H105
H117
CR1017
H130
CR1030
OSC 4
H144
CR1006
H106
H118
CR1018
H131
CR1031
OSC 5
H145
CR1007
H107
H119
CR1019
H132
CR1032
OSC 6
H146
CR1008
H108
H120
CR1020
H133
CR1033
OSC 9
H147
CR1009
H109
H121
CR1021
H134
CR1034
OSC 10
H148
CR1010
H110
H122
CR1022
H135
CR1035
OSC 8
H149
CR1011
H111
H123
CR1023
H136
CR1036
OSC 7
H150
CR1012
H112
H124
CR1024
J51
✱ ☐
C1001 1UF
H83
+
H84
J21
P4
W-V
▲
C1002 .1UF
H90
BK
AUTO MONITOR PL19B226856
Y
P3
J61
P2
J52
P1
J53
J12
P601

SEE PAGE 4 FOR OUTLINE DIAGRAM
AND SEE PAGE 12 FOR SCHEMATIC
DIAGRAM & PARTS LIST OF AUTOMATIC
MONITOR 19B226856.

(19D423954, Rev. 1)

INTERCONNECTION DIAGRAM

TWO-TONE ENCODE DECODE
AUTOMATIC MONITOR
Porta • Mobile II RADIO


CHANNEL GUARD
PL19C321017G1-2
TONE B DISABLE
TONE A DISABLE
TX KEYED 5.4V
7.5V
TONE IN
TONE SWITCH
TONE OUT
GROUND
GROUND

PARTS LIST

LBI-30530

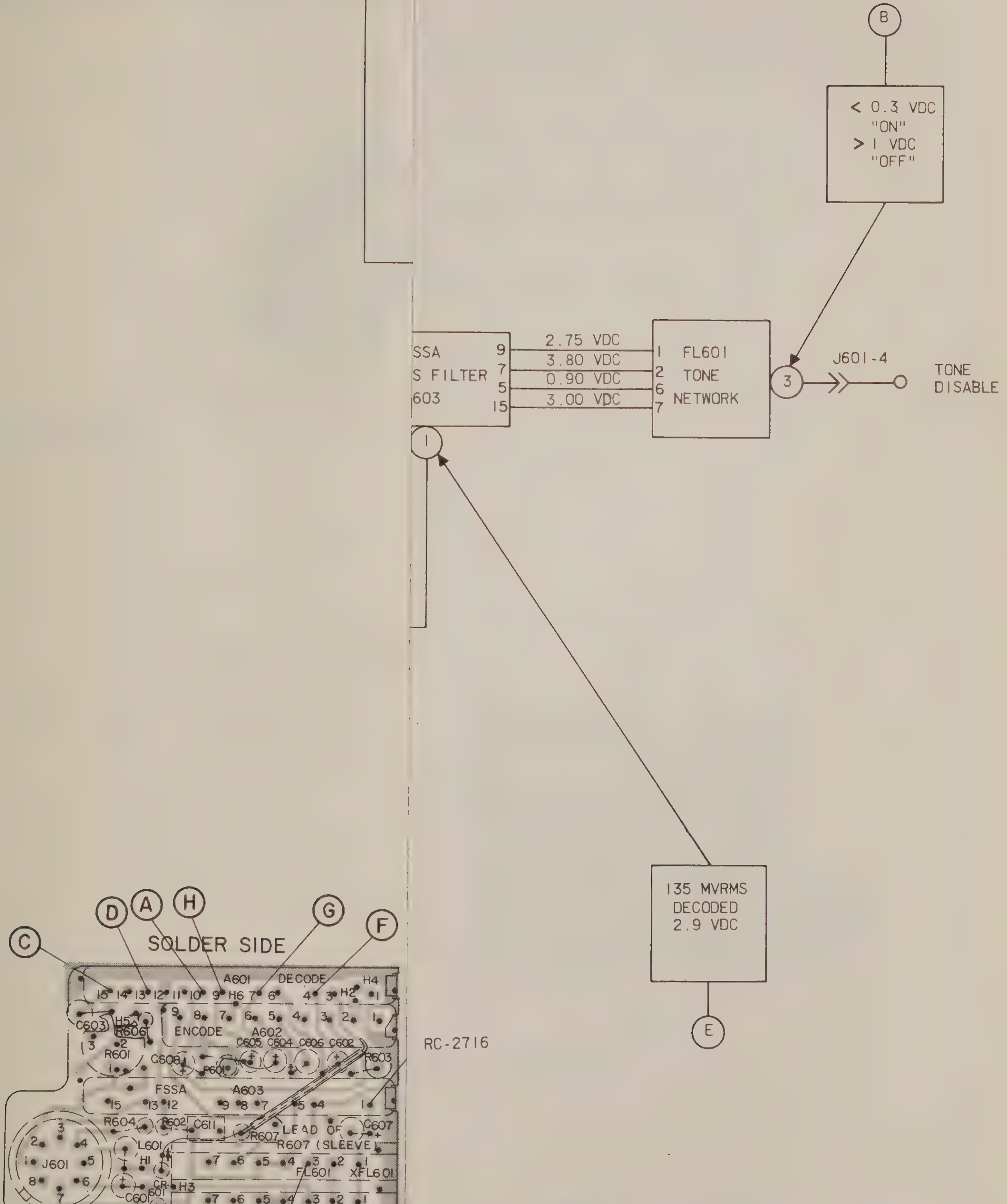
PM II CHANNEL GUARD MOD KIT
2 TONE ENCODE
19A130977G5

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - CAPACITORS - - - - - - - -
C1001	5491674P1	Tantalum: 1.0 µf +40-20%, 10 VDCW; sim to Sprague Type 162D.
C1002	19A116192P14	Ceramic: .1 µf ±20%, 50 VDCW; sim to Erie USCC CW20C104-M2.
		- - - - - - - - - - RESISTORS - - - - - - - - -
R604 and R605	3R151P104K	Composition: 100,000 ohms ±10%, 1/8 w.
		- - - - - - - - - - SWITCHES - - - - - - - - -
S1003		SWITCH ASSEMBLY 19B226809G14
		- - - - - - - - DIODES AND RECTIFIERS - - - - - -
CR1 and CR2	19A115250P1	Silicon.
		- - - - - - - - - - SWITCHES - - - - - - - - -
	19A116648P2	Switch, toggle: DPDT; sim to C and K Components.
		- - - - - - - - - - - CABLES - - - - - - - - -
W1003		CABLE, RELAY ASSEMBLY 19B226806G9
		- - - - - - - - - - INDUCTORS - - - - - - - - -
L1 and L2	19B209420P114	Coil, RF: 1.20 µh ±10%, 0.18 ohms DC res max; sim to Jeffers 4436-1.
		- - - - - - - - - - - PLUGS - - - - - - - - - -
P1	19A127569G1	Plug: 8 contacts.
P2 thru P4	19A115834P4	Contact, electrical: sim to AMP 2-332070-9.
		- - - - - - - - - - SOCKETS - - - - - - - - - -
XFL602		Socket. Includes shell and contacts. (Order separately).
	19D416714P1	Shell.
	19B219681P1	Contact, electrical. (Quantity 7).
		- - - - - - - - - MISCELLANEOUS - - - - - - - -
	19B227357G1	Insulator. (Used with Channel Guard Board).
	19C320975P1	Seal. (Used with S1003).
	19B226358G9	Faceplate (For S1003).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

S

Uni
dec


B
< 0.3 VDC
"ON"
> 1 VDC
"OFF"
SSA
S FILTER
603
9
7
5
15
2.75 VDC
3.80 VDC
0.90 VDC
3.00 VDC
1
2
6
7
FL601
TONE
NETWORK
3
J601-4
TONE
DISABLE
1
135 MVRMS
DECODED
2.9 VDC
E
C
D
A
H
G
F
SOLDER SIDE
A601
DECODE
H4
15
14
13
12
11
10
9
H6
7
6
4
3
H2
1
9
8
7
6
5
4
3
2
1
C603
H5
R606
ENCODE
A602
C605
C604
C606
C602
R601
C608
R601
R603
FSSA
A603
13
12
R604
R602
C611
R607
LEAD OF
R607 (SLEEVE)
C607
J601
L601
H1
FL601
XFL601
CR601
H3
C601
R605
FL602
XFL602
B
RC-2716

(RC-2726)
(19C321528
(19D417783

TROUBLESHOOTING PROCEDURE

DECODER CHANNEL GUARD 19C321017G1

Issue 5

THIS ELEM DIAG APPLIES TO	
MODEL NO	REV LETTER

IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.

ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF=MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH=MILLIHENRYS OR H=HENRYS.

NOTE:

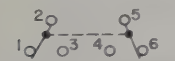
ALL WIRES T-28 UNLESS OTHERWISE SPECIFIED.

▲ NOT PRESENT IN LOW BAND (30-50 MHZ). (1 PART)

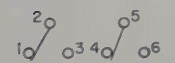
☐ NOT PRESENT IN HI-BAND (132-174 MHz). (1 PART)

✱ NOT PRESENT IN 450 (406-512 MHz). (1 PART)

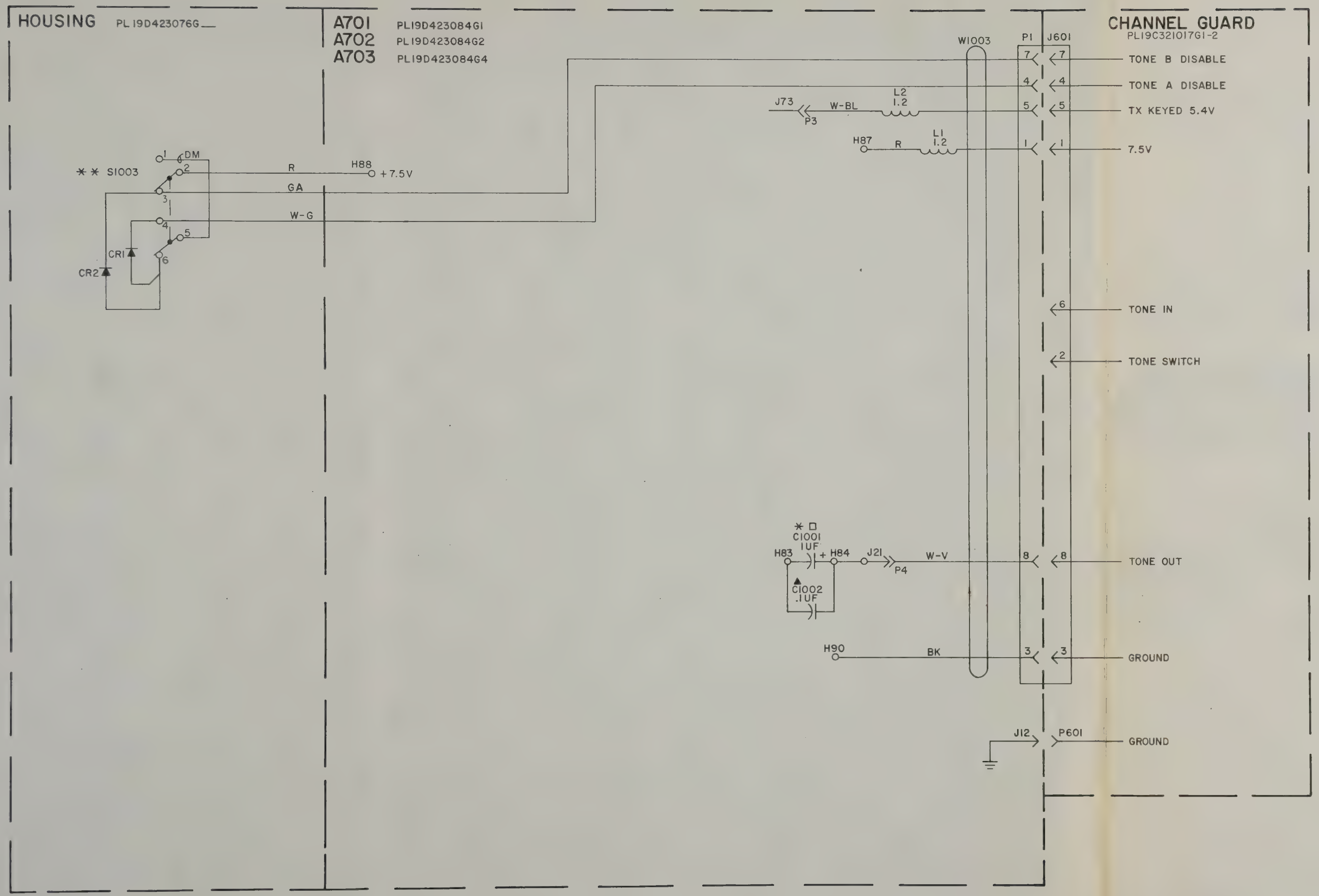
✱✱ S1003 SHOWN IN TONE "A" POSITION
(FOR OTHER POSITIONS SEE BELOW)



S1003 IN OFF POSITION



S1003 IN TONE "B" POSITION



HOUSING
PL19D423076G
A701 PL19D423084G1
A702 PL19D423084G2
A703 PL19D423084G4
CHANNEL GUARD
PL19C321017G1-2
W1003
P1
J601
✱✱ S1003
1
DM
2
3
4
5
6
CR1
CR2
R
H88
+7.5V
GA
W-G
J73
P3
W-BL
L2
1.2
H87
R
L1
1.2
7
4
5
1
6
2
8
3
TONE B DISABLE
TONE A DISABLE
TX KEYED 5.4V
7.5V
TONE IN
TONE SWITCH
✱☐
C1001
1UF
H83
+
H84
J21
P4
W-V
▲
C1002
.1UF
TONE OUT
H90
BK
GROUND
J12
P601
GROUND

(19D423957, Rev.3)

INTERCONNECTION DIAGRAM

TWO-TONE ENCODE
Porta • Mobile II RADIO

PARTS LIST

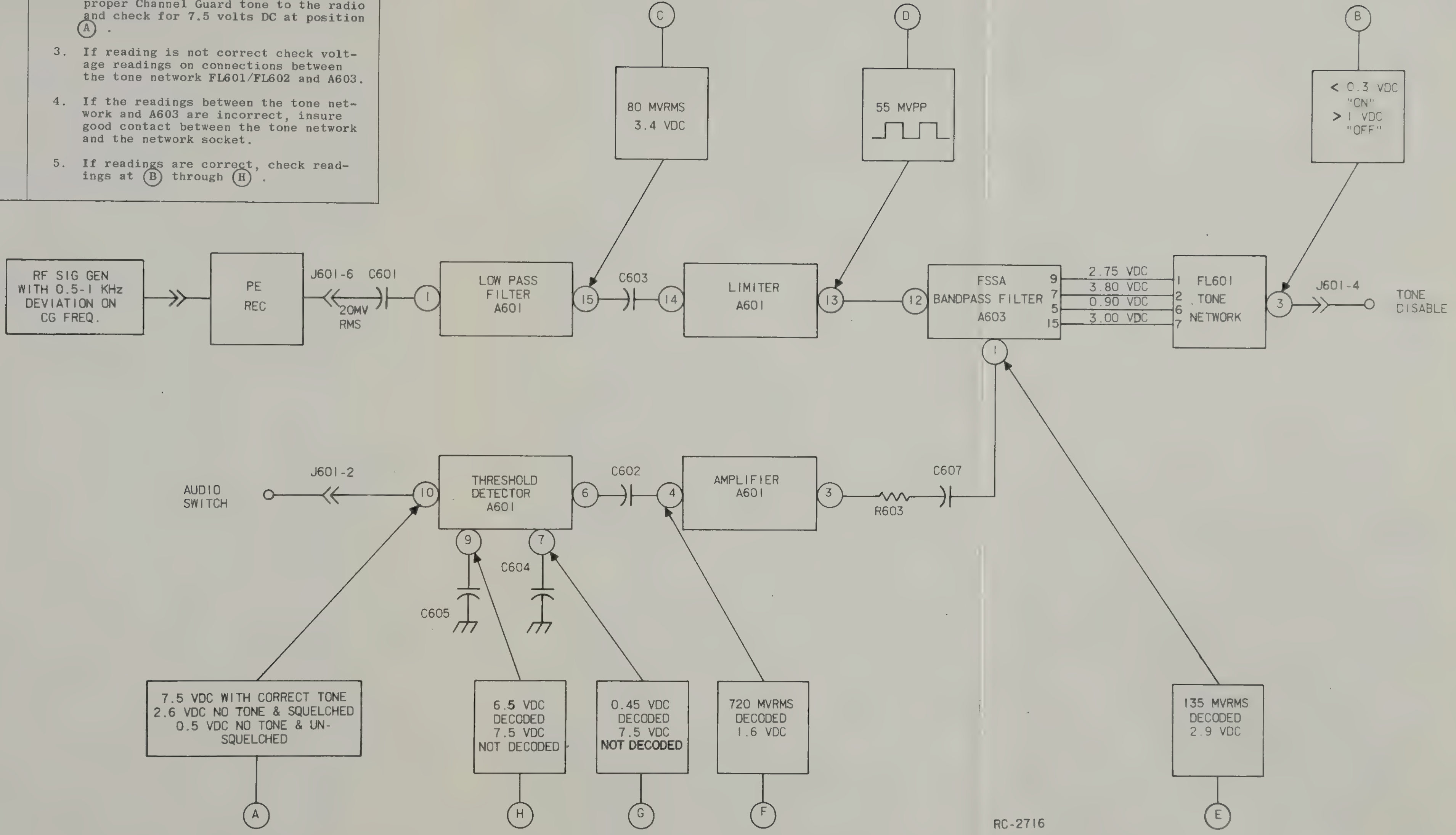
LBI-30530

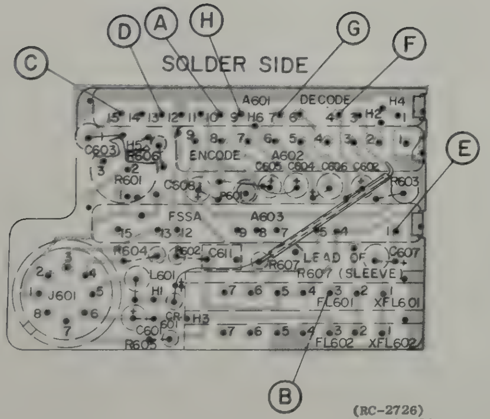
PM II CHANNEL GUARD MOD KIT
2 TONE ENCODE
19A130977G5

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - - CAPACITORS - - - - - - - - -
C1001	5491674P1	Tantalum: 1.0 µf +40-20%, 10 VDCW; sim to Sprague Type 162D.
C1002	19A116192P14	Ceramic: .1 µf ±20%, 50 VDCW; sim to Erie USCC CW20C104-M2.
		- - - - - - - - - - - RESISTORS - - - - - - - - - -
R604 and R605	3R151P104K	Composition: 100,000 ohms ±10%, 1 8 w.
		- - - - - - - - - - - SWITCHES - - - - - - - - - -
S1003		SWITCH ASSEMBLY 19B226809G14
		- - - - - - - - - DIODES AND RECTIFIERS - - - - - -
CR1 and CR2	19A115250P1	Silicon.
		- - - - - - - - - - - SWITCHES - - - - - - - - - -
	19A116648P2	Switch, toggle: DPDT; sim to C and K Components.
		- - - - - - - - - - - - - CABLES - - - - - - - - - -
W1003		CABLE, RELAY ASSEMBLY 19B226806G9
		- - - - - - - - - - - INDUCTORS - - - - - - - - - -
L1 and L2	19B209420P114	Coil, RF: 1.20 µh ±10%, 0.18 ohms DC res max; sim to Jeffers 4436-1.
		- - - - - - - - - - - - PLUGS - - - - - - - - - - -
P1	19A127569G1	Plug: 8 contacts.
P2 thru P4	19A115834P4	Contact, electrical: sim to AMP 2-332070-9.
		- - - - - - - - - - - SOCKETS - - - - - - - - - - -
XFL602		Socket. Includes shell and contacts. (Order separately).
	19D416714P1	Shell.
	19B219681P1	Contact, electrical. (Quantity 7).
		- - - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19B227357G1	Insulator. (Used with Channel Guard Board).
	19C320975P1	Seal. (Used with S1003).
	19B226358G9	Faceplate (For S1003).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

SYMPTOM	PROCEDURE
Unit will not decode.	1. Place Channel Guard switch S601/S602 in the "OFF" position and check for proper receiver operation. 2. If the receiver operates properly, set S601 to the "ON" position or S602 to position "A" or "B". Apply the proper Channel Guard tone to the radio and check for 7.5 volts DC at position Ⓐ. 3. If reading is not correct check voltage readings on connections between the tone network FL601/FL602 and A603. 4. If the readings between the tone network and A603 are incorrect, insure good contact between the tone network and the network socket. 5. If readings are correct, check readings at Ⓑ through Ⓗ.


Ⓒ
80 MVRMS
3.4 VDC
Ⓓ
55 MVPP
Ⓑ
< 0.3 VDC "ON"
> 1 VDC "OFF"
RF SIG GEN WITH 0.5-1 KHz DEVIATION ON CG FREQ.
PE REC
J601-6
C601
20MV RMS
1
LOW PASS FILTER A601
15
C603
14
LIMITER A601
13
12
FSSA BANDPASS FILTER A603
9
7
5
15
2.75 VDC
3.80 VDC
0.90 VDC
3.00 VDC
1
2
6
7
FL601 TONE NETWORK
3
J601-4
TONE DISABLE
1
AUDIO SWITCH
J601-2
10
THRESHOLD DETECTOR A601
6
C602
4
AMPLIFIER A601
3
R603
C607
9
7
C604
C605
7.5 VDC WITH CORRECT TONE
2.6 VDC NO TONE & SQUELCHED
0.5 VDC NO TONE & UNSQUELCHED
Ⓐ
6.5 VDC DECODED
7.5 VDC NOT DECODED
Ⓗ
0.45 VDC DECODED
7.5 VDC NOT DECODED
Ⓖ
720 MVRMS DECODED
1.6 VDC
Ⓕ
135 MVRMS DECODED
2.9 VDC
Ⓔ
RC-2716

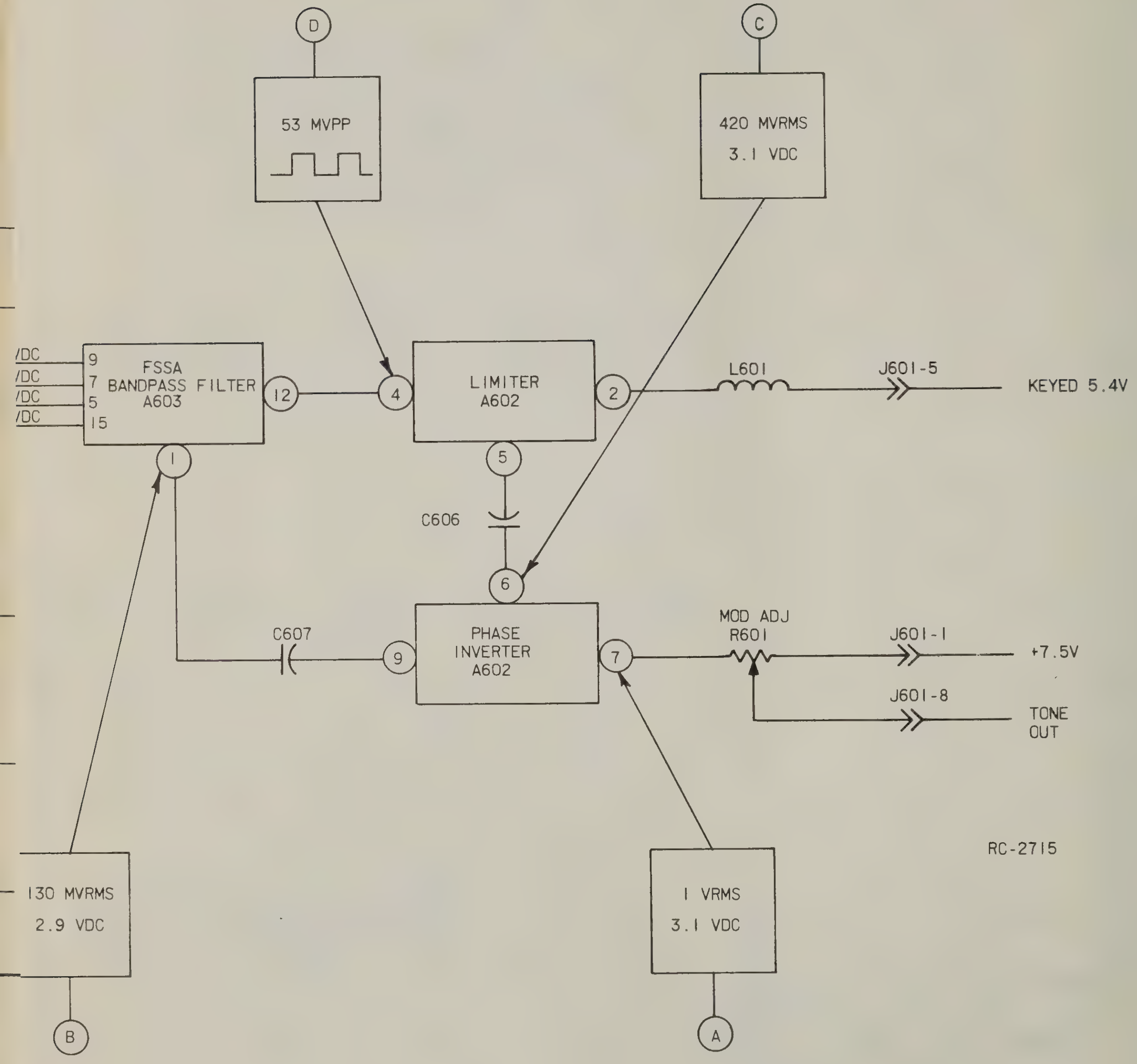

Ⓒ
Ⓓ
Ⓐ
Ⓗ
Ⓖ
Ⓕ
Ⓔ
Ⓑ
SOLDER SIDE
A601
DECODE
H4
H2
H6
H5
C603
R606
ENCODE
A602
R601
C606
C605
C604
C602
R603
FSSA
A603
R604
C611
R607
C607
LEAD OF R607 (SLEEVE)
L601
H1
J601
FL601
XFL601
C601
R605
H3
FL602
XFL602

(RC-2726)
(19C321528, Rev. 1)
(19D417783, Sh. 2, Rev. 6)

TROUBLESHOOTING PROCEDURE

DECODER CHANNEL GUARD 19C321017G1

Issue 5


D
53 MVPP
C
420 MVRMS
3.1 VDC
/DC
/DC
/DC
/DC
9
7
5
15
FSSA
BANDPASS FILTER
A603
12
1
4
LIMITER
A602
2
5
L601
J601-5
KEYED 5.4V
C606
6
C607
9
PHASE
INVERTER
A602
7
MOD ADJ
R601
J601-1
+7.5V
J601-8
TONE
OUT
130 MVRMS
2.9 VDC
B
1 VRMS
3.1 VDC
A
RC-2715

MOBILE RADIO

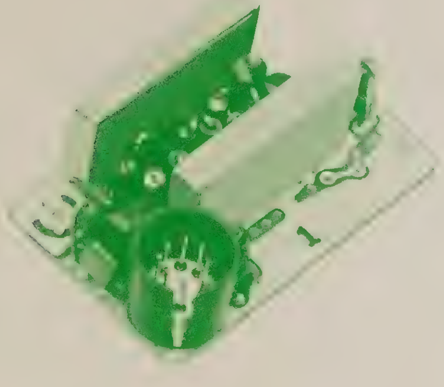
VEHICULAR REPEATER

TYPE 90 ENCODE/DECODE MODEL 4EK18A13

Maintenance Manual LBI30814 A

DATAFILE FOLDER — DF5051

ENCODE/DECODE MODEL 4EK18A13



SPECIFICATIONS *

Used With	Vehicular Repeater
Tone Frequencies	1050 Hz to 3000 Hz
Frequency Stability	±0.3%
Transmit Drain	3.6 Milliamperes
Temperature Range	-30°C to +60°C (-22°F to +140°F)
Nominal Input Voltage Requirements	+8.5 VDC +5.4 VDC

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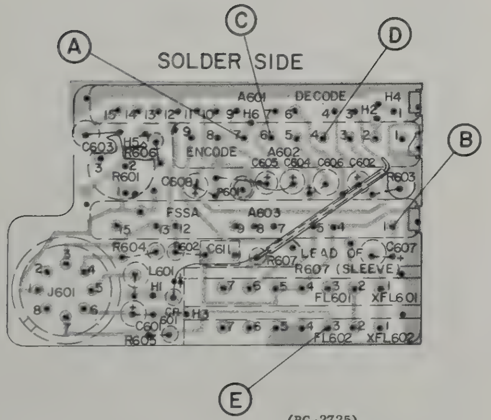
*he specifications are intended primarily for the use of the serviceman. Refer to the appropriate Specification Sheet for the complete specifications.

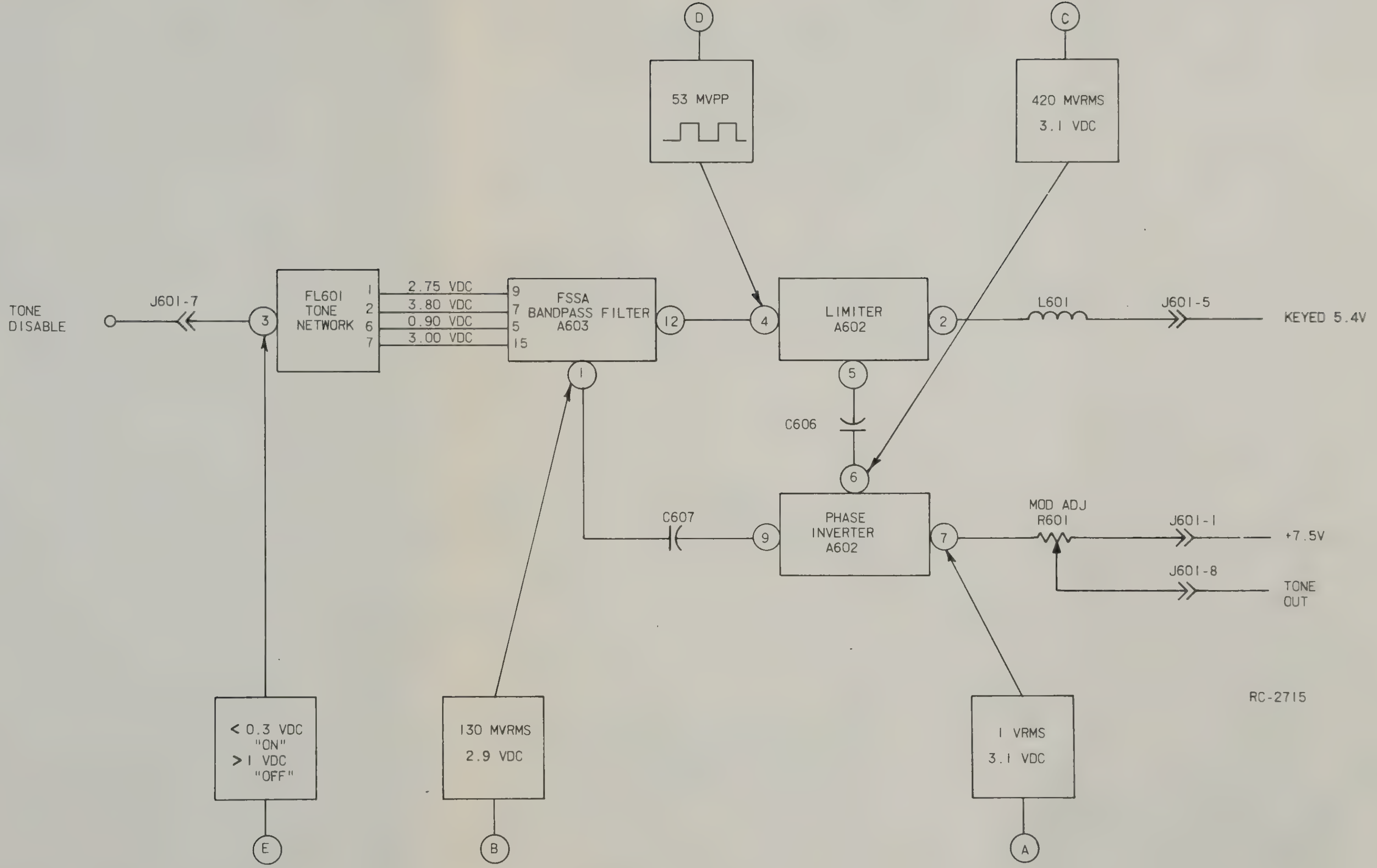
GENERAL ELECTRIC

TROUBLESHOOTING

SYMPTOM	PROCEDURE
Unit will not encode	1. Place Channel Guard switch S602 in tone "A" or "B" position and check for 3.1 volts DC at Ⓐ . S601 can be in any position. 2. If reading is correct, check Mod. Adj. R601 then check the transmitter oscillator module. 3. If reading is not correct check voltage readings on connections between the tone network FL601 and A603. 4. If the readings between the tone network and A603 are incorrect, insure good contact between the tone network and the network socket. 5. If readings are correct check readings at Ⓑ through Ⓔ .


A
C
D
B
E
SOLDER SIDE
A601
DECODE
ENCODE
A602
R601
C603
R606
C608
C605
C604
C606
C602
R603
FSSA
A603
R604
C602
C611
LEAD OF R607 (SLEEVE)
C607
J601
L601
H1
FL601
XFL601
FL602
XFL602
R605
H2
H3
H4
H5
H6

(RC-2725)
(19C321528, Rev. 1)
(19D417783, Sh. 2, Rev. 6)


D
53 MVPP
C
420 MVRMS
3.1 VDC
TONE DISABLE
J601-7
3
FL601 TONE NETWORK
1
2
6
7
2.75 VDC
3.80 VDC
0.90 VDC
3.00 VDC
9
7
5
15
FSSA BANDPASS FILTER A603
12
1
4
LIMITER A602
2
L601
J601-5
KEYED 5.4V
5
C606
6
C607
9
PHASE INVERTER A602
7
MOD ADJ R601
J601-1
+7.5V
J601-8
TONE OUT
< 0.3 VDC "ON"
> 1 VDC "OFF"
E
130 MVRMS
2.9 VDC
B
1 VRMS
3.1 VDC
A
RC-2715

TROUBLESHOOTING PROCEDURE

ENCODER CHANNEL GUARD 19C321017G1 & G2

Issue 5

MOBILE RADIO

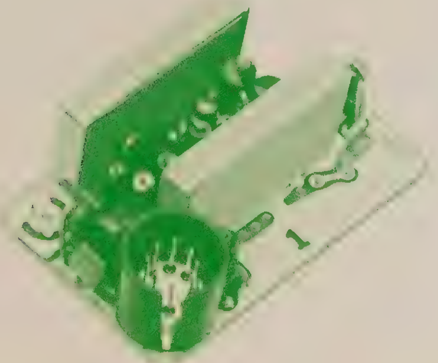
VEHICULAR REPEATER

TYPE 90 ENCODE/DECODE MODEL 4EK18A13

Maintenance Manual LBI30814 A

DATAFILE FOLDER — DF5051

ENCODE/DECODE MODEL 4EK18A13



SPECIFICATIONS *

Used With	Vehicular Repeater
Tone Frequencies	1050 Hz to 3000 Hz
Frequency Stability	±0.3%
Transmit Drain	3.6 Milliamperes
Temperature Range	-30^0C to $+60^0$C (-22^0F to $+140^0$F)
Nominal Input Voltage Requirements	+8.5 VDC +5.4 VDC

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he specifications are intended primarily for the use of the serviceman. Refer to the appropriate Specification Sheet for the complete specifications.

GENERAL ELECTRIC

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SPECIFICATIONS .... Cover
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NOTE

Although the highest DC voltage in the Type 90 Decoder is supplied by a vehicular battery, high currents may be drawn under short circuit conditions. These currents can possibly heat metal objects such as tools, rings, watchbands, etc., enough to cause burns. Be careful when working near energized circuits!

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DESCRIPTION

Type 90 Encoder/Decoder Model 4EK18A13 is a tone encoder/decoder assembly for operating on standard Type 90 tone frequencies of 1000 to 3000 Hz. The encoder/decoder assembly generates and detects the Type 90 tone frequencies used to establish and control the priorities of the vehicular repeaters as they arrive and depart the operational area. The assembly uses three Integrated Circuit modules consisting of Input Amplifier A601, Limiter-Switch A602, and Selective Amplifier A603. A typical diagram of the Limiter Switch is shown in Figure 1 and a typical diagram of the Input Amplifier is shown in Figure 2.

CIRCUIT ANALYSIS

The Type 90 encode circuit is switched "on" or "off" by Q8 on the System board under control of the $\overline{\text{TYPE 90 ENCODE ENABLE}}$ signal. This signal is generated on the Logic board.

When the $\overline{\text{Type 90 ENCODE ENABLE}}$ signal is present (logic "0"), 8.5 Volts is applied to pin 7 of the Input Amplifier module. This turns on Q4, turning off Q3. Q3 removes the ground on the emitter of Q2, allowing Q2 to turn on. Tone from the Selective Amplifier module is applied to pin 5 of the Input Amplifier and is coupled through Q2 to Pin 4 where it is capacitively coupled through C601 to amplifier Q5. The amplifier output is applied to pin 2 of the Limiter Switch module where it activates tone switch (Q4).

The encode tone output is applied to the transmitter through pin 8 of the Input Amplifier to J601-8 on the System board where it is amplified and applied to the MIC HI input lead.

Inserting the PE radio into the Vehicular Charger or releasing the REPEATER ENABLED switch on the Vehicular Charger causes the logic board to generate a Type 90 Encode Enable signal which removes 8.5 volts from pin 7 of the Input Amplifier module, turning off Q4. When Q4 turns off, Q3 turns on. With Q3 turned on, Q2 is held off thereby

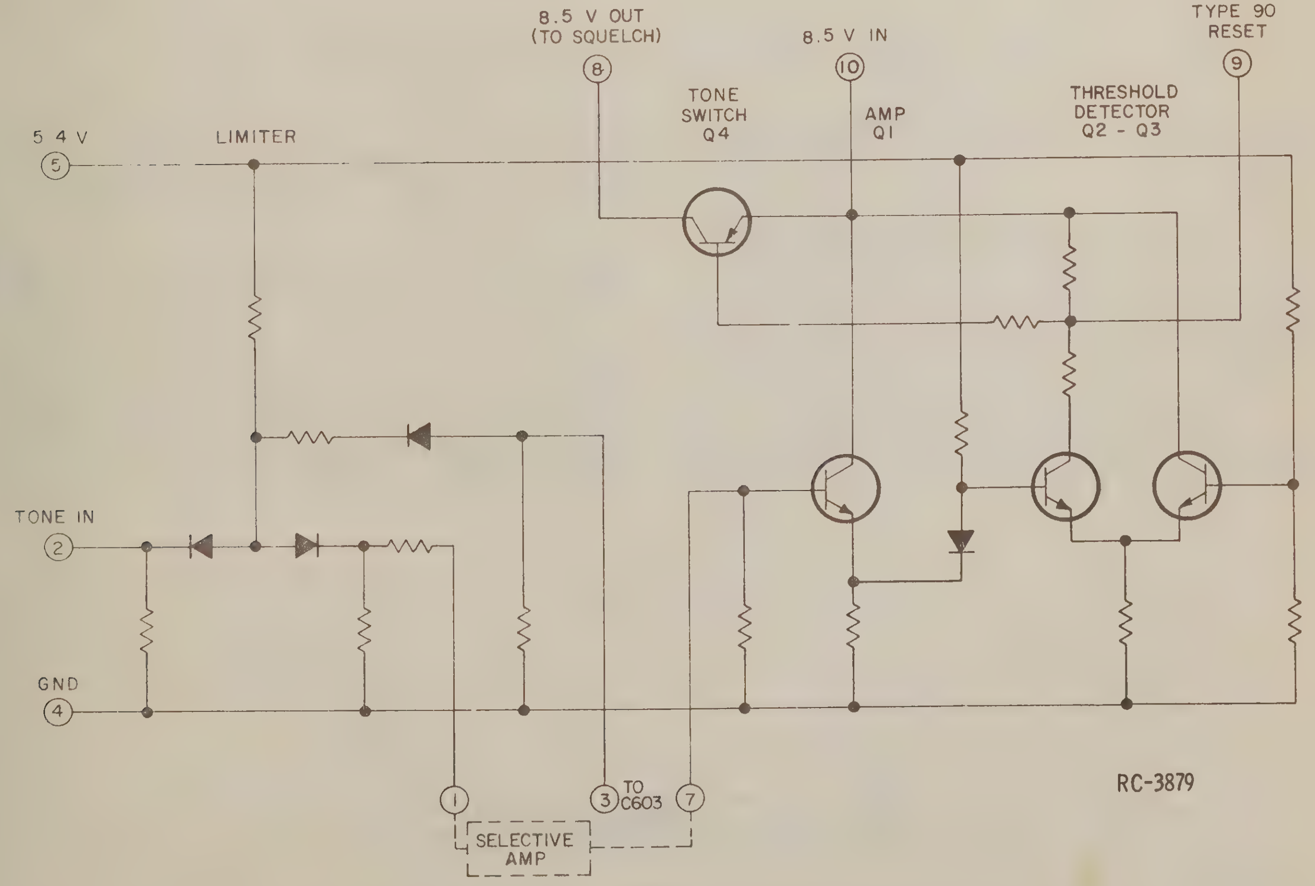

Figure 1 - Typical Limiter Switch Circuit

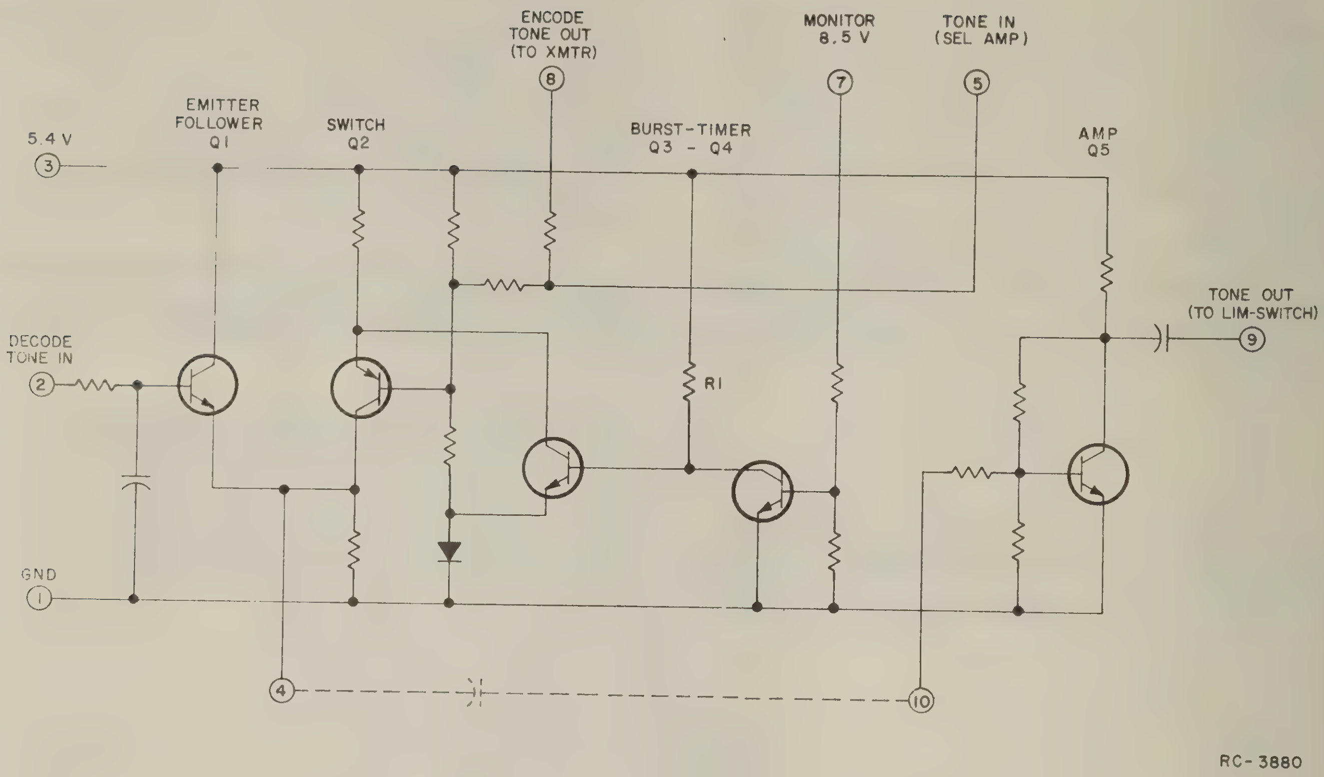
ENCODE TONE OUT (TO XMTR)
MONITOR 8.5 V
TONE IN (SEL AMP)
5.4 V
EMITTER FOLLOWER Q1
SWITCH Q2
BURST-TIMER Q3 - Q4
AMP Q5
TONE OUT (TO LIM-SWITCH)
DECODE TONE IN
R1
GND
3
8
7
5
9
2
1
4
10
RC-3880

Figure 2 - Typical Input Amplifier Circuit

lowering the emitter of Q1 to near A-. This prevents any tone output to the transmitter.

Under these conditions audio from R701-3 (Volume Hi) is applied to the base of emitter-follower Q1 on the Input Amplifier module. The output of Q1 is capacity-coupled to the base of amplifier Q5. The amplifier output is applied to the limiter circuit on the Limiter-Switch module.

Any tone present in the signal is limited by diodes CR1 and CR2, and the output applied through pin 1 to the Selective Amplifier module. If the incoming tone is of the proper frequency, the output of the Selective Amplifier will be just sufficient to operate the detector circuit (Q1 thru Q3).

The positive half cycles of the Selective Amplifier output turns on Q1, which over-rides the diode and turns on Q2. Turning on Q2 causes its collector to drop to ground potential, turning on the PNP tone switch Q4. When conducting, the 8.5 Volts at the collector of Q4 is applied to the Type 90 decode circuit on the Logic board. The voltage is connected through H42 on the System board to P904-14.

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WORLD HEADQUARTERS• LYNCHBURG, VIRGINIA 24502 U.S.A.

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U.S.A.

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Printed in U.S.A.

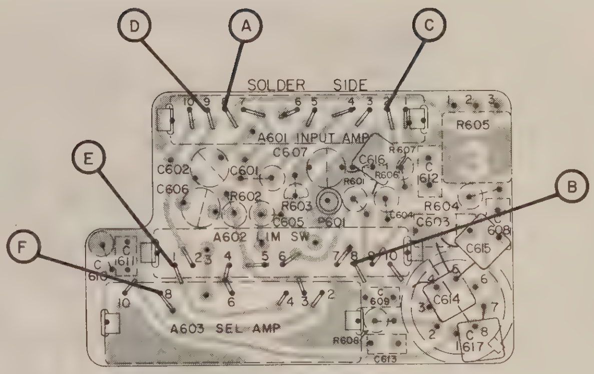
TROUBLESHOOTING

Always connect the board to ground (G11) when removed from the radio for troubleshooting.

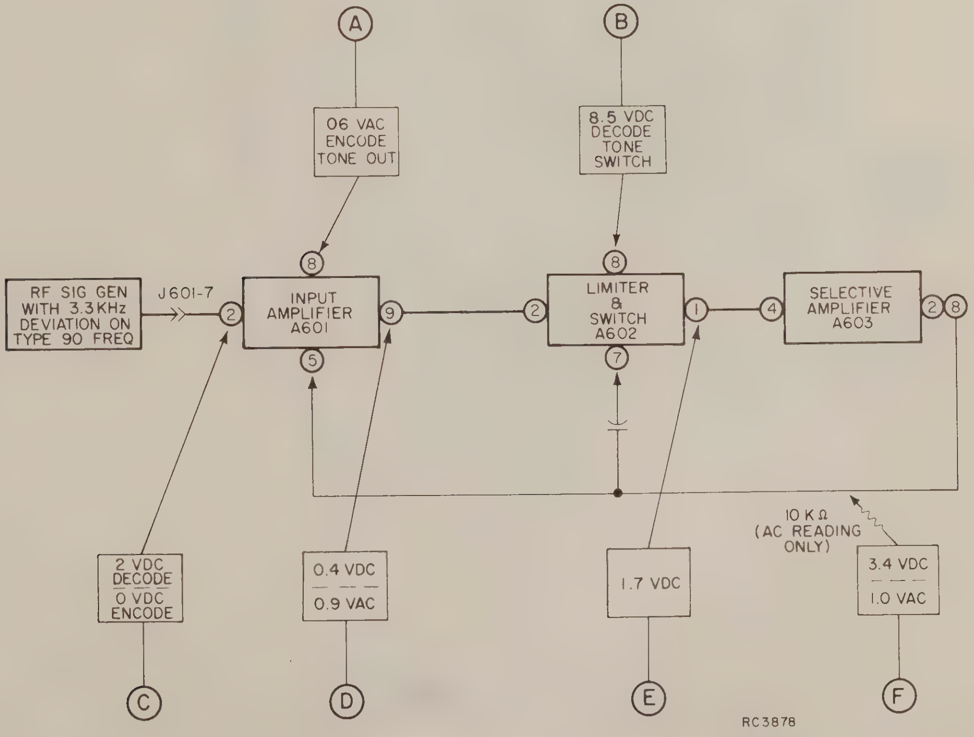
SYMPTOM	PROCEDURE
Unit won't encode	1. Place Type 90 switch S1301 in the Monitor (encode) position, and check for .06 volts RMS at position Ⓐ . Key the transmitter and check for the reading at Ⓐ to drop to zero in approximately one second (pulsed tone). 2. If these readings are correct, check the transmitter audio circuit and modulation setting. 3. If the readings are not correct, isolate the defective module by checking readings Ⓒ through Ⓕ .
Unit won't decode	1. Place Type 90 switch S1301 in the Reset and then in the Monitor position and check for proper operation of the receiver. 2. If the receiver operates properly, place the switch in the Reset and then the Normal position. Apply the proper Type 90 tone to the radio and check for 7.4 volts DC at position Ⓑ . Place the switch in the Reset and then the Normal position and check for zero volts at Ⓑ . 3. If the readings are not correct, isolate the defective module by checking readings Ⓒ through Ⓕ.

- CAUTION -

Do not ground Pins 2 or 8 on Selective Amplifier A603, or Pin 5 on input amplifier A601. To do so will destroy the Selective Amplifier module.


D
A
C
B
E
F
SOLDER SIDE
A601 INPUT AMP
A602 LIM SW
A603 SEL AMP
R605
C607
C616
R607
R606
C612
C602
C601
C606
R602
R603
R601
R604
C604
C603
C605
C601
C608
C615
C611
C610
C614
C609
R608
C613
C617

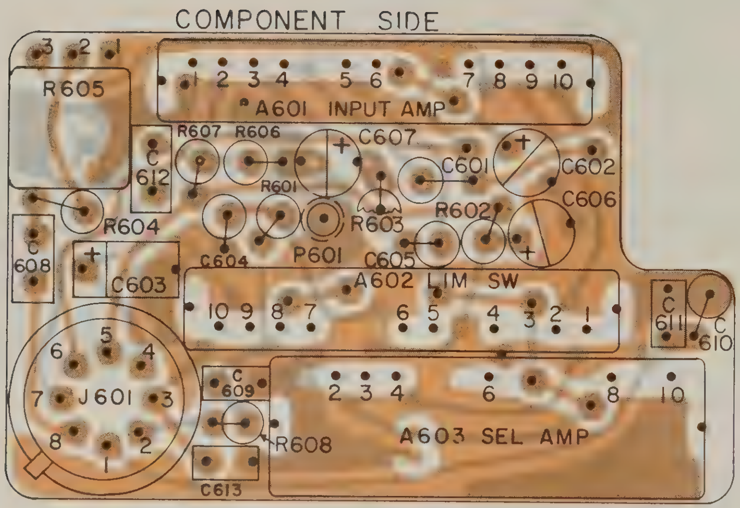
(RC-2144)
(19C317940, Rev. 2)
(19B219040, Sh. 2, Rev. 3)


A
B
06 VAC ENCODE TONE OUT
8.5 VDC DECODE TONE SWITCH
RF SIG GEN WITH 3.3KHz DEVIATION ON TYPE 90 FREQ
J601-7
INPUT AMPLIFIER A601
LIMITER & SWITCH A602
SELECTIVE AMPLIFIER A603
8
2
9
5
2
8
1
7
4
2
8
10 KΩ (AC READING ONLY)
2 VDC DECODE
0 VDC ENCODE
0.4 VDC
0.9 VAC
1.7 VDC
3.4 VDC
1.0 VAC
C
D
E
F
RC3878

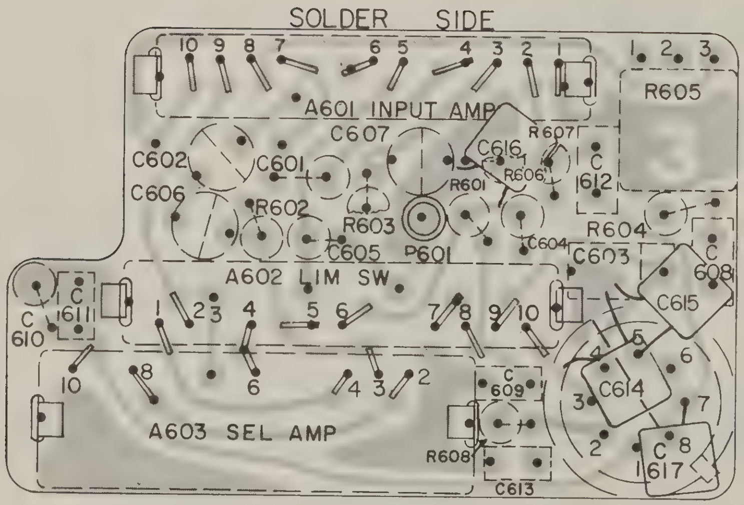
TROUBLESHOOTING PROCEDURE

TYPE 90 ENCODER/DECODER MODEL 4EK18A13

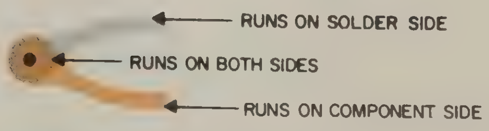
Issue 1


COMPONENT SIDE
R605
A601 INPUT AMP
R607
R606
C607
C601
C602
C606
C612
R601
R603
R602
R604
P601
C605
C604
C608
C603
A602 LIM SW
C611
C610
J601
C609
R608
A603 SEL AMP
C613

(19C317940, Rev. 2)
(19B219040, Sh. 1, Rev. 3)
(19B219040, Sh. 2, Rev. 3)

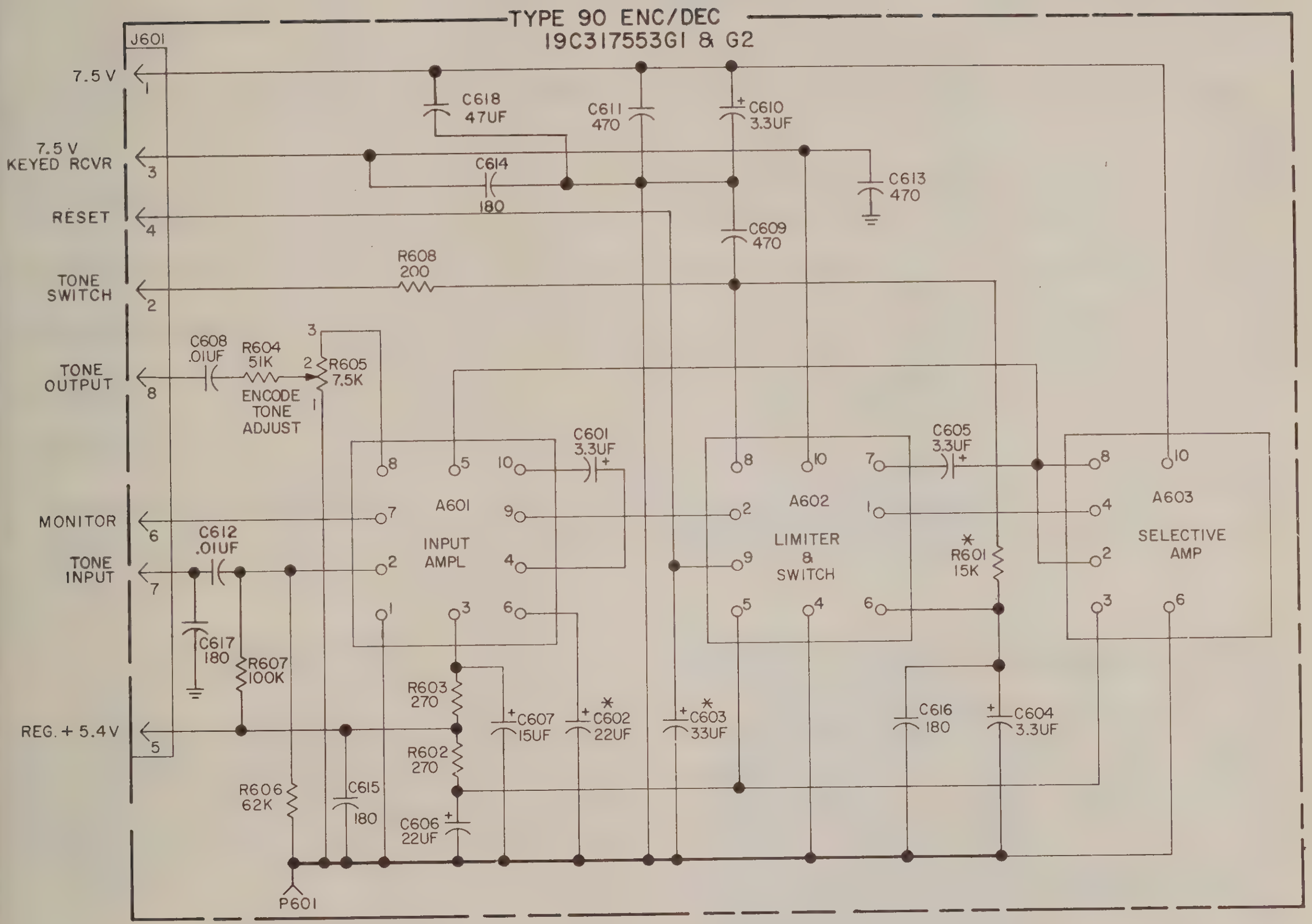

SOLDER SIDE
A601 INPUT AMP
R605
C607
C616
R607
C602
C601
R606
C612
R601
C606
R602
R603
R604
C605
P601
C604
C603
C608
A602 LIM SW
C615
C611
C610
C614
C609
A603 SEL AMP
R608
C617
C613

(19C317940, Rev. 2)
(19B219040, Sh. 2, Rev. 3)


RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE

OUTLINE DIAGRAM

TYPE 90 ENCODER/DECODER
MODEL 4EK18A13


TYPE 90 ENC/DEC
19C317553G1 & G2
J601
7.5 V
1
7.5 V KEYED RCVR
3
RESET
4
TONE SWITCH
2
TONE OUTPUT
8
MONITOR
6
TONE INPUT
7
REG. + 5.4V
5
C618 47UF
C611 470
C610 3.3UF
C614 180
C613 470
C609 470
R608 200
C608 .01UF
R604 51K
R605 7.5K
ENCODE TONE ADJUST
C601 3.3UF
A601
INPUT AMPL
C605 3.3UF
A602
LIMITER & SWITCH
A603
SELECTIVE AMP
R601 15K
C612 .01UF
C617 180
R607 100K
R603 270
C607 15UF
C602 22UF
C603 33UF
C616 180
C604 3.3UF
R602 270
R606 62K
C615 180
C606 22UF
P601

✱ NOT PRESENT IN GROUP 2

ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG = 1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.

IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.

SEE APPLICABLE PRODUCTION CHANGE SHEETS IN INSTRUCTION BOOK SECTION DEALING WITH THIS UNIT, FOR DESCRIPTION OF CHANGES UNDER EACH REVISION LETTER.

THIS ELEM DIAG APPLIES TO

MODEL NO	REV LETTER
4EK18A12 4EK18A13	

(19C327066, Rev. 2)

SCHEMATIC DIAGRAM

TYPE 90 ENCODER/DECODER
MODEL 4EK18A13

PARTS LIST

TYPE 90 ENCODER/DECODER
19C317553G2
ISSUE 2

SYMBOL	GE PART NO.	DESCRIPTION
A601	19C317061G2	Input Amplifier.
A602	19C317014G2	Limiter and Switch.
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C601	5491674P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C604 and C605	5491674P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C606	19C307102P15	Tantalum: 22 µf ±20%, 6 VDCW; sim to Component Inc G226R.
C607	19C307102P14	Tantalum: 15 µf ±20%, 10 VDCW; sim to Component Inc G156R.
C608	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121 SPECIAL.
C609	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-050-W5R.
C610	5491674P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C611	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-050-W5R.
C612	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121 SPECIAL.
C613	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-050-W5R.
C614 thru C617	19A700229P73	Ceramic: 180 pf ±10%, 100 VDCW; temp coef -3300 PPM/°C.
		- - - - - - - JACKS AND RECEPTACLES - - - - - -
J601	19C331182P1	Terminal, feed-thru.
		- - - - - - - - - - - PLUGS - - - - - - - - - -
P601	19A115834P4	Contact, electrical: sim to Amp 2-332070-9.
		- - - - - - - - - - RESISTORS - - - - - - - - -
R602 and R603	19A700106P49	Composition: 270 ohms ±5%, 1/4 w.
R604	3R152P513J	Composition: 51K ohms ±5%, 1/4 w.
R605*	19A116412P5	Variable, cermet: 10K ohms ±10%, 1/2 w; sim to Helipot Model 62 PR.
		Earlier than REV A:
	19A116093P1	Variable, carbon film: 7.5K ohms ±20%, 0.20 w; sim to Centralab Series 3 Type 620-1.
R606	3R152P623J	Composition: 62K ohms ±5%, 1/4 w.
R607	19A700106P111	Composition: 100K ohms ±5%, 1/4 w.
R608	19A700106P46	Composition: 200 ohms ±5%, 1/4 w.
		ASSOCIATED PARTS
		NOTE: When reordering give GE Part Number and specify exact frequency needed.
A603	19D413245G5	Selective Amplifier. 847.5 Hz. (STANDARD)
	19D413245G4	Selective Amplifier. 1050-3000 Hz. (OPTIONAL)

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

MOBILE RADIO

LBI32571A

INSTALLATION INSTRUCTIONS
FOR
COMBINED RUSOS MODIFICATION KIT
19A143668G1

TABLE OF CONTENTS

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DESCRIPTION	1
CIRCUIT ANALYSIS	1
OUTLINE DIAGRAM	2
SCHEMATIC DIAGRAM	3
PARTS LIST	3
INSTALLATION INSTRUCTIONS	4

DESCRIPTION

This Modification Kit provides a Combined RUSOS Board which is installed in a dual receiver radio unit to provide a common output function whenever either receiver selects a good signal. The Combined RUSOS Board is installed as shown on Installation Instruction 19D432613.

CIRCUIT ANALYSIS

A good signal received by the main receiver produces a high at H3. This high forward biases the base of Q4. Q4 conducts and a low appears at the RUSOS output H8.

The auxiliary receiver must be enabled (low at H2) before the auxiliary receiver RUI input at H6 will create a low at the RUSOS output H8. A good signal on the auxiliary receiver changes the input at H6 from a high to a low, turning off Q2. With the auxiliary receiver enabled, Q3 will not conduct and the high at the collector of Q2 forward biases CR7. This forward biases the base of Q4, causing it to conduct and a low to appear at H8.

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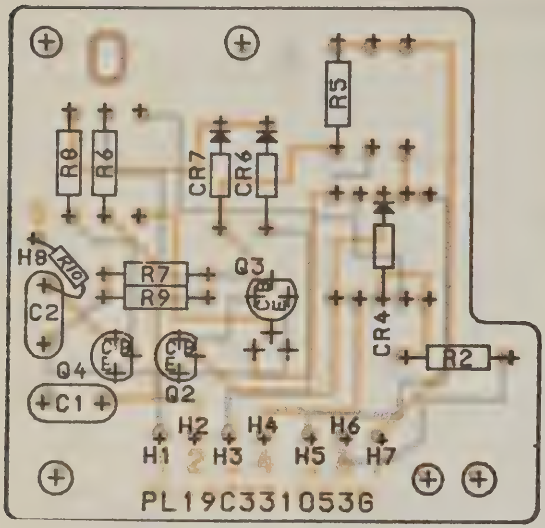
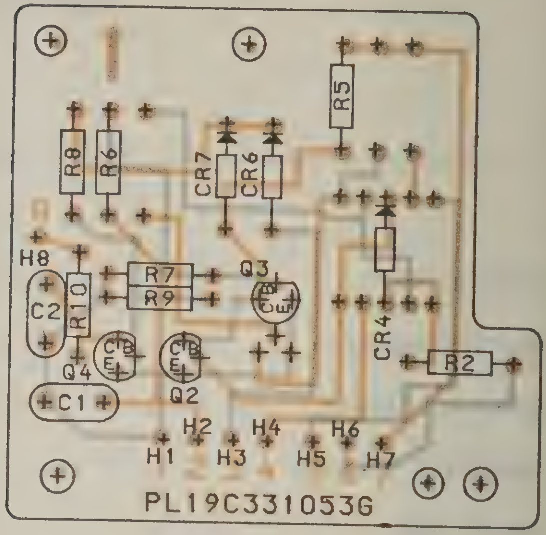
PWB BOARD REV. 0


R5
R8
R6
CR7
CR6
H8
R10
R7
R9
Q3
C2
CR4
R2
Q4
Q2
C1
H2
H4
H6
H1
H3
H5
H7
PL19C331053G

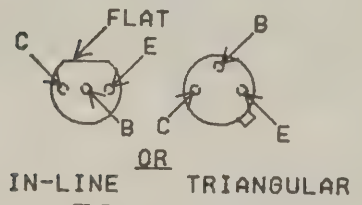
(19C331053, Rev. 0)
(19A143659, Sh. 1, Rev. 0)
(19A143659, Sh. 2, Rev. 0)

PWB BOARD REV. 1


R5
R8
R6
CR7
CR6
H8
R7
R9
Q3
C2
R10
CR4
R2
Q4
Q2
C1
H2
H4
H6
H1
H3
H5
H7
PL19C331053G

(19C331053, Rev. 1)
(19A143659, Sh. 1, Rev. 1)
(19A143659, Sh. 2, Rev. 1)

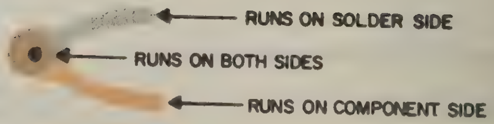
LEAD IDENTIFICATION
FOR Q2 - Q4


FLAT
C
E
B
C
B
E
OR
IN-LINE
TRIANGULAR

TOP VIEW

NOTE: LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

CONNECTION CHART			
FROM	TO	WIRE	LENGTH
H1	LET HANG	SF24-G	13.00 ±.25
H2	↑	SF24-W	↑
H3		SF24-BK	
H6		SF24-Y	
H7	↓	SF24-R	↓
H8	LET HANG	SF24-BR	13.00 ±.25

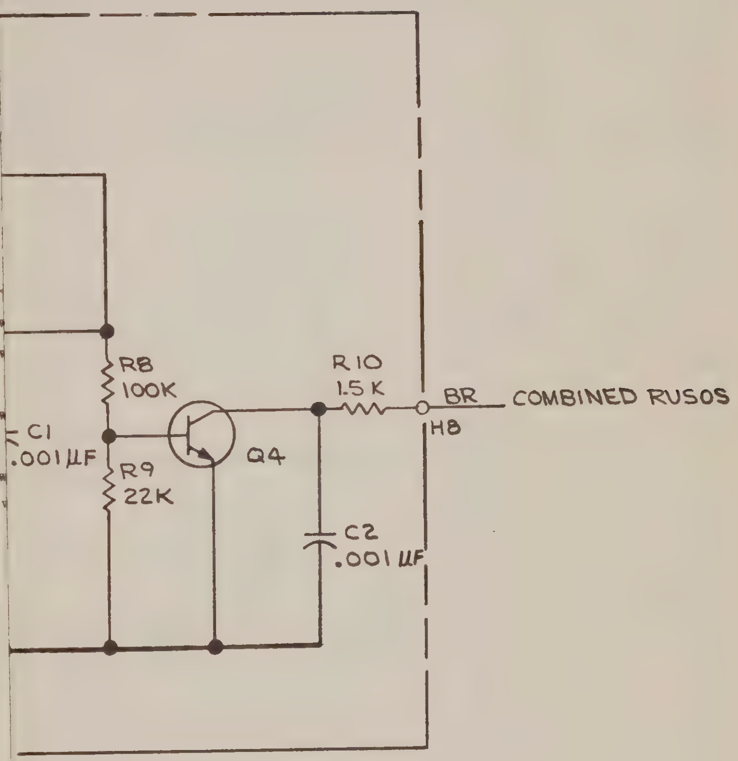

RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE

PARTS LIST

COMBINED RUSOS
19C331053G1
Issue 2

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - - CAPACITORS -
C1 and C2	19A116655P19	Ceramic disc: 1000 pf ±20%, 100 RMC Type JF Discap.
		- - - - - - - - - DIODES AND RECTI
CR4	19A115250P1	Silicon, fast recovery, 225 mA,
CR6 thru CR9	19A115250P1	Silicon, fast recovery, 225 mA,
		- - - - - - - - - - - TRANSISTORS
Q2 thru Q3	19A700023P1	Silicon, NPN; sim to Type 2N3904
		- - - - - - - - - - - RESISTORS -
R2	19A700106P107	Composition: 68K ohms ±5%, 1/4
R5	19A700106P87	Composition: 10K ohms ±5%, 1/4
R6	19A700106P111	Composition: 100K ohms ±5%, 1/4
R7	19A700106P95	Composition: 22K ohms ±5%, 1/4
R8	19A700106P111	Composition: 100K ohms ±5%, 1/4
R9	19A700106P95	Composition: 22K ohms ±5%, 1/4
R10	19A700106P7	Composition: 1.5K ohms ±5, 1/4

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCT

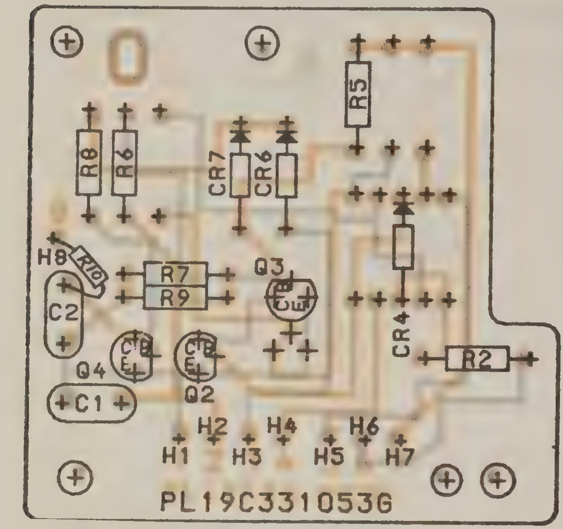


(19C331071, Rev. 1)

SCHEMATIC DIAGRAM
& PARTS LIST

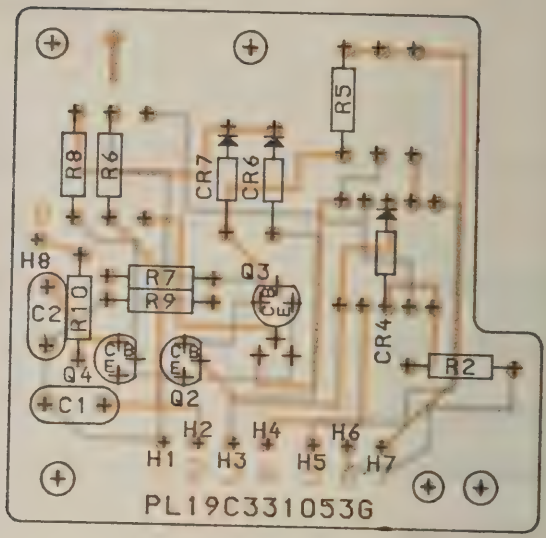
COMBINED RUSOS BOARD

PWB BOARD REV. 0


R5
R8
R6
CR7
CR6
H8
R10
R7
R9
Q3
C2
CR4
Q4
Q2
R2
C1
H1
H2
H3
H4
H5
H6
H7
PL19C331053G

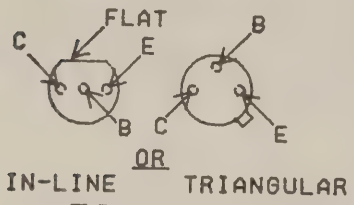
(19C331053, Rev. 0)
(19A143659, Sh. 1, Rev. 0)
(19A143659. Sh. 2, Rev. 0)

PWB BOARD REV. 1


R5
R8
R6
CR7
CR6
H8
R7
R9
R10
Q3
C2
CR4
Q4
Q2
R2
C1
H1
H2
H3
H4
H5
H6
H7
PL19C331053G

(19C331053, Rev. 1)
(19A143659, Sh. 1, Rev. 1)
(19A143659, Sh. 2, Rev. 1)

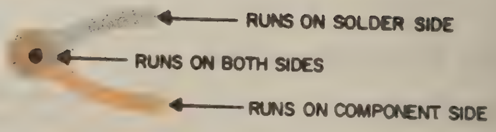
LEAD IDENTIFICATION
FOR Q2 - Q4


FLAT
C
E
B
B
C
E
OR
IN-LINE
TRIANGULAR

TOP VIEW

NOTE: LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

CONNECTION CHART			
FROM	TO	WIRE	LENGTH
H1	LET HANG	SF24-G	13.00 ±.25
H2	↑	SF24-W	↑
H3		SF24-BK	
H6		SF24-Y	
H7	↓	SF24-R	↓
H8	LET HANG	SF24-BR	13.00 ±.25

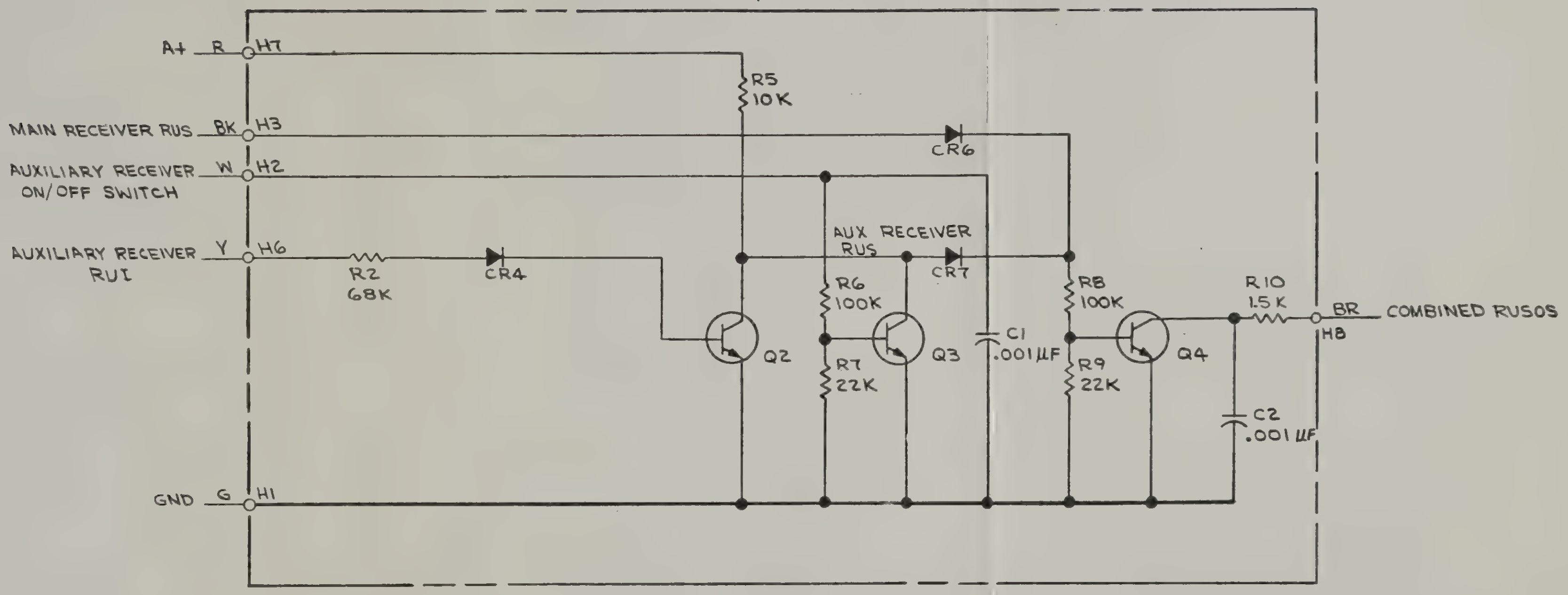

RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE

PARTS LIST

COMBINED RUSOS
19C331053G1
Issue 2

SYMBOL	GE PART NO.	DESCRIPTION
		---------- CAPACITORS ----------
C1 and C2	19A116655P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
		-------- DIODES AND RECTIFIERS ------
CR4	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
CR6 thru CR9	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
		---------- TRANSISTORS --------
Q2 thru Q3	19A700023P1	Silicon, NPN; sim to Type 2N3904.
		---------- RESISTORS ----------
R2	19A700106P107	Composition: 68K ohms ±5%, 1/4 w.
R5	19A700106P87	Composition: 10K ohms ±5%, 1/4 w.
R6	19A700106P111	Composition: 100K ohms ±5%, 1/4 w.
R7	19A700106P95	Composition: 22K ohms ±5%, 1/4 w.
R8	19A700106P111	Composition: 100K ohms ±5%, 1/4 w.
R9	19A700106P95	Composition: 22K ohms ±5%, 1/4 w.
R10	19A700106P7	Composition: 1.5K ohms ±5, 1/4 w.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES


A+
R
H7
R5
10K
MAIN RECEIVER RUS
BK
H3
CR6
AUXILIARY RECEIVER ON/OFF SWITCH
W
H2
AUXILIARY RECEIVER RUI
Y
H6
R2
68K
CR4
AUX RECEIVER RUS
CR7
R6
100K
R7
22K
Q2
Q3
C1
.001µF
R8
100K
R9
22K
Q4
R10
1.5 K
BR
H8
COMBINED RUSOS
C2
.001µF
GND
G
H1

NOTES:
1. ALL WIRES ARE SF24 UNLESS OTHERWISE SPECIFIED.

(19C331071, Rev. 1)

ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.

SCHEMATIC DIAGRAM
& PARTS LIST

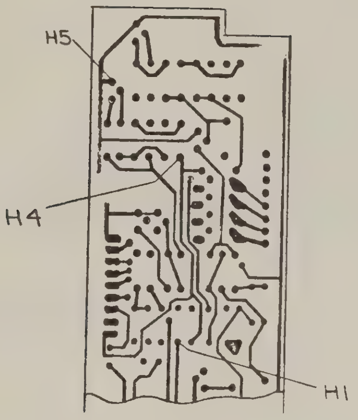
COMBINED RUSOS BOARD

Issue 2

ARY CONTROL BD
983A

THESE INSTRUCTIONS COVER THE INSTALLATION OF MODIFICATION KIT PL19A143668G1 FOR MODIFYING MICOR RADIO.

1. MOUNT COMBINED RUSOS BD 19C331053G1 USING (3) #4 THD FORMING SCREWS 19B201074P204 AS SHOWN.
2. MAKE CONNECTIONS PER CONNECTION CHART



SOLDER SIDE OF
AUXILIARY CONTROL BD.
TLN5983A

CONNECTION CHART

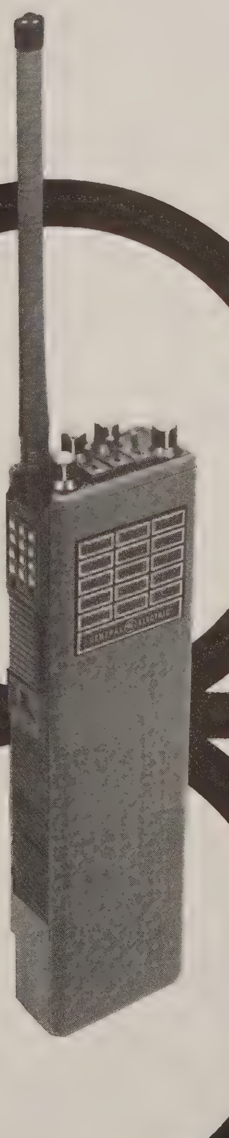
FROM COMBINED RUSOS BD 19C331053	WIRE	TO
H1	SF24-G	AUX. CONTROL BD. TLN5983A H5
H2	SF24-W	AUX. CONTROL BD. TLN5983A R30
H3	SF24-BK	AUX. CONTROL BD. TLN5983A R33
H6	SF24-Y	AUX. CONTROL BD. TLN5983A H1
H7	SF24-R	AUX. CONTROL BD. TLN5983A H4
H8	SF24-BR	P901-28

MOBILE RADIO

MPR

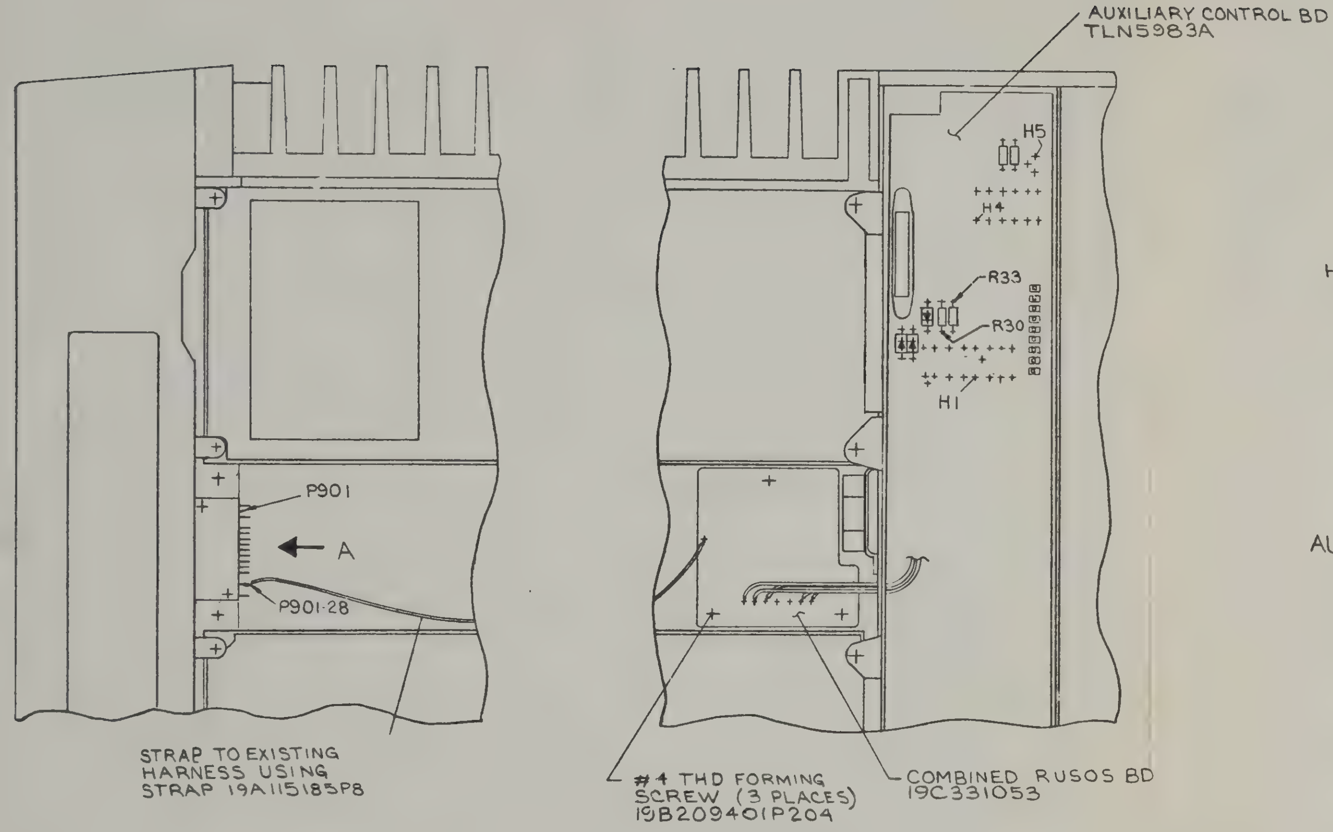
MAINTENANCE MANUAL LBI30771A

DATAFILE FOLDER DF9047

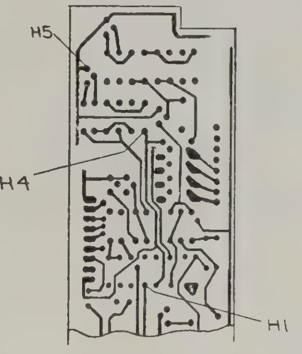


138–174 MHz
PERSONAL
TWO-WAY FM RADIO
P2B and P2C
COMBINATIONS

GENERAL ELECTRIC


AUXILIARY CONTROL BD
TLN5983A
H5
H4
R33
R30
H1
P901
A
P901-28
STRAP TO EXISTING
HARNESS USING
STRAP 19A115185P8
#4 THD FORMING
SCREW (3 PLACES)
19B209401P204
COMBINED RUSOS BD
19C331053

PARTIAL BOTTOM VIEW OF MICOR RADIO
(COVER REMOVED)



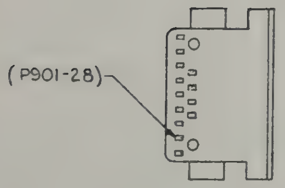
SOLDER SIDE OF
AUXILIARY CONTROL BD.
TLN5983A

THESE INSTRUCTIONS COVER THE INSTALLATION OF MODIFICATION KIT PL19A143668G1 FOR MODIFYING MICOR RADIO.

1. MOUNT COMBINED RUSOS BD 19C331053G1 USING (3) #4 THD FORMING SCREWS 19B201074P204 AS SHOWN.
2. MAKE CONNECTIONS PER CONNECTION CHART

CONNECTION CHART

FROM COMBINED RUSOS BD 19C331053	WIRE	TO
H1	SF24-G	AUX. CONTROL BD. TLN5983A H5
H2	SF24-W	AUX. CONTROL BD. TLN5983A R30
H3	SF24-BK	AUX. CONTROL BD. TLN5983A R33
H6	SF24-Y	AUX. CONTROL BD. TLN5983A H1
H7	SF24-R	AUX. CONTROL BD. TLN5983A H4
H8	SF24-BR	P901-28



VIEW 'A'
REAR VIEW OF P901

(19D432613, Rev. 0)

INSTALLATION INSTRUCTIONS

COMBINED RUSOS BOARD

MOBILE RADIO

MPR

MAINTENANCE MANUAL LBI30771A

DATAFILE FOLDER DF9047

138–174 MHz
PERSONAL
TWO-WAY FM RADIO
P2B and P2C
COMBINATIONS

GENERAL ELECTRIC

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SPECIFICATIONS

SYSTEM

	Combination	
Dimensions (H x W x D)	P2B	P2C
(Less battery pack)	5.81" x 2.85" x 1.5" 14.76 cm x 7.24 cm x 3.81 cm	6.46" x 2.85" x 1.5" 16.41 cm x 7.24 cm x 3.81 cm
(With 750 mAh battery pack)	8.01" x 2.85" x 1.5" 20.27 cm x 7.24 cm x 3.81 cm	8.86" x 2.85" x 1.5" 21.92 cm x 7.24 cm x 3.81 cm
(With 1200 mAh battery pack)	9.36" x 2.85" x 1.5" 23.77 cm x 7.24 cm x 3.81 cm	10.01" x 2.85" x 1.5" 25.42 cm x 7.24 cm x 3.81 cm
Weight		
(Less battery pack)	20 oz.	21 oz.
(With 750 mAh battery pack)	30 oz.	31 oz.
(With 1200 mAh battery pack)	33 oz.	34 oz.
Operable Temperature Range	-30 to +60°C	
Current Drain (Less Options)		
Standby	23.5 milliamps	
Receive (Rated Audio)	147 milliamps	
Transmit		
2.5 Watts	1.2 amperes	
6.0 Watts	2.4 amperes	

TRANSMIT

Type Numbers	KT167B/C	KT168B/C
Power Output (Adjustable)	1 to 2.5 Watts	1 to 6 Watts
Spurious		
Radiated	-71 dB	-75 dB
Conducted	-71 dB	-75 dB
Multiplication	x 3	
RF Load Impedance	50 ohms	
Modulation Deviation	0.2 to 5.5 kHz (Factory set at 4.5 kHz)	
Audio Sensitivity	12 millivolts at 3 kHz	
Audio Frequency Response	Within +1 and -3 dB of a 6 dB/octave pre-emphasis from 300 to 3000 Hz.	
Audio Distortion	Less than 3% at 300 to 3000 Hz and 3 kHz deviation.	
Maximum Frequency Spread	12 MHz (No degradation) 24 MHz (1 dB degradation)	

SPECIFICATIONS

RECEIVE

	Type Numbers	
Frequency Range		
138-174 MHz	ER109B/C (High Intermodulation)	ER110B/C (High Sensitivity)
Sensitivity		
20 dB NQ	0.5 μV	0.25 μV
12 dB SINAD	0.35 μV	0.18 μV
Critical Squelch	0.25 μV	0.13 μV
Selectivity		
20 kHz	-70 dB	-65 dB
25 kHz	-85 dB	-80 dB
30 kHz	-95 dB	-90 dB
Intermodulation	-80 dB	-75 dB
Spurious & Image	-80 dB	-75 dB
Maximum Frequency Spread		
Maximum Performance	2 MHz	4 MHz
1 dB degredation	3 MHz	6 MHz
3 dB degredation	4 MHz	10 MHz
6 dB degredation	8 MHz	12 MHz
Channel Spacing	30 kHz	
Audio Output	500 milliwatts	
Audio Frequency Response	Within +2 and -8 dB of a 6 dB/octave de-emphasis from 300 to 3000 Hz (1000 Hz rereference)	
Audio Distortion	Less than 5% at 1000 Hz	
Modulation Acceptance	+7 kHz	

BATTERY PACK

Capacities	750 & 1200 mAh
Maximum Charge Rate	1 hour
Fuse Rating	5 amperes
Charging Temperature Range	+5° to 45°C
Discharging Temperature Range	-30° to +60°C

COMBINATION NOMENCLATURE

(THIRD DIGIT B-MEDIUM PACKAGE)

DIGITS 1 & 2	DIGIT 3	DIGITS 4 & 5	DIGIT 6	DIGIT 7	DIGIT 8	DIGIT 9	DIGIT 10
PRODUCT CODE	PACKAGE	FREQUENCY RANGE *	CHANNEL SPACING	RF POWER	MAXIMUM CHANNEL CAPACITY	CONTROL	POWER SOURCE
P2	B MEDIUM	HH 138-150.8 MHz	6 30 KHz	5 1.7-3.8 WATTS	A 1 CHANNEL	E STANDARD	N 750 mAh NiCd
		JJ 150.8-162 MHz		6 3.9-6.4 WATTS	B 2 CHANNELS		M 1200 mAh NiCd
		KK 162-174 MHz			C 3 CHANNELS		X NO BATT
					D 4 CHANNELS		
					E 5 CHANNELS		
					F 6 CHANNELS		

* NO CROSS
SPLIT OFFERED

IF OPTION D IS ANYTHING OTHER THAN "C",
DIGIT 8 MUST BE A-D.

RC3906 SH. 1

STRUCTURED OPTIONS

(THIRD DIGIT B-MEDIUM PACKAGE)

A OPTION	B OPTION	C OPTION	D OPTION	E OPTION	F OPTION	G OPTION	H OPTION	J OPTION	K OPTION	L OPTION	M OPTION
A 1 TX FREQUENCY	A 1 RX FREQUENCY	0 NONE	0 NONE	0 NONE	0 NONE	0 NONE	0 NONE	0 NONE	0 NONE	0 NONE	0 NONE
B 2 TX FREQUENCY	B 2 RX FREQUENCY	2 1-TONE CG ENC	2 1-TONE CG ENC			S SLM	V VOX	H HI/LO PWR MAN	3 ALT IF		
C 3 TX FREQUENCY	C 3 RX FREQUENCY	U 1-TONE CG ENC/DEC	U 1-TONE CG ENC/DEC			P PSLM	2 CPRSR	1 HI/LO PWR AUTO			
D 4 TX FREQUENCY	D 4 RX FREQUENCY		3 MULTI-CG ENC-AUTO				W VOX/ CPRSR				
E 5 TX FREQUENCY	E 5 RX FREQUENCY		E MULTI-CG ENC-MAN								
F 6 TX FREQUENCY	F 6 RX FREQUENCY		W MULTI-CG ENC/DEC-AUTO								
X NO XTALS	X NO XTALS		C MULTI-CG ENC/DEC-MAN								

STRUCTURED OPTIONS ARE OPTIONS ORDERED AS PART OF THE COMBINATION NOMENCLATURE. ONLY ONE OR NONE IN EACH GROUP CAN BE ORDERED.

RC3906A SH. 2

COMBINATION NOMENCLATURE

(THIRD DIGIT C-EXTENDED PACKAGE)

DIGITS 1 & 2	DIGIT 3	DIGITS 4 & 5	DIGIT 6	DIGIT 7	DIGIT 8	DIGIT 9	DIGIT 10
PRODUCT CODE	PACKAGE	FREQUENCY RANGE *	CHANNEL SPACING	RF POWER	MAXIMUM CHANNEL CAPACITY	CONTROL	POWER SOURCE
P2	C EXTENDED	HH 138-150.8 MHz	6 30 KHz	5 1.7-3.8 WATTS	A 1 CHANNEL	E STANDARD	N 750 mAh NiCd
		JJ 150.8-162 MHz		6 3.9-6.4 WATTS	B 2 CHANNELS		M 1200 mAh NiCd
		KK 162-174 MHz			C 3 CHANNELS		X NC BATT
					D 4 CHANNELS		
					E 5 CHANNELS		
					F 6 CHANNELS		
					G 7 CHANNELS		
					H 8 CHANNELS		
					J 9 CHANNELS		
					K 10 CHANNELS		

* NO CROSS SPLIT OFFERED

IF OPTION D IS ANYTHING OTHER THAN "3"
DIGIT 8 MUST BE A-H.

RC3906 SH. 3

STRUCTURED OPTIONS

(THIRD DIGIT C-EXTENDED PACKAGE)

A OPTION	B OPTION	C OPTION	D OPTION	E OPTION	F OPTION	G OPTION	H OPTION	J OPTION	K OPTION	L OPTION	M OPTION
A 1 TX FREQUENCY	A 1 RX FREQUENCY	0 NONE	0 NONE	0 NONE	0 NONE	0 NONE	0 NONE	0 NONE	0 NONE	0 NONE	0 NONE
B 2 TX FREQUENCY	B 2 RX FREQUENCY	2 1-TONE CG ENC	2 1-TONE CG ENC			S SLM	V VOX	H HI/LO PWR MAN	3 ALT IF		
C 3 TX FREQUENCY	C 3 RX FREQUENCY	U 1-TONE CG ENC/DEC	U 1-TONE CG ENC/DEC			F PSLM	2 CPRSR	I HI/LO PWR AUTO			
D 4 TX FREQUENCY	D 4 RX FREQUENCY		3 MULTI-CG ENC-AUTO				W VOX/ CPRSR				
E 5 TX FREQUENCY	E 5 RX FREQUENCY		E MULTI-CG ENC-MAN								
F 6 TX FREQUENCY	F 6 RX FREQUENCY		W MULTI-CG ENC/DEC-AUTO								
G 7 TX FREQUENCY	G 7 RX FREQUENCY		C MULTI-CG ENC/DEC-MAN								
H 8 TX FREQUENCY	H 8 RX FREQUENCY										
J 9 TX FREQUENCY	J 9 RX FREQUENCY										
K 10 TX FREQUENCY	K 10 RX FREQUENCY										
X NO XTALS	X NO XTALS										

STRUCTURED OPTIONS ARE OPTIONS ORDERED AS PART OF THE COMBINATION NOMENCLATURE. ONLY ONE OR NONE IN EACH GROUP CAN BE ORDERED.

RC3906A SH. 4

DESCRIPTION

General Electric's MPR radio is a completely modularized, two-way, FM communication system, designed to afford performance specifications equivalent or, more generally, superior to both domestic and international specification requirements. The MPR radio offers outstanding advances in reliability, Option flexibility and repairability.

Each MPR radio, depending on the combination, uses approximately 15 plug-in circuit modules. Each module utilizes a thick film monolythic hybrid integrated circuit, containing, when possible, the complete electronic function; not requiring any externally mounted components to make it work. Each circuit module plugs into a specific socket on the system board.

The MPR transmit circuit employs FM modulated third mode oscillator modules to achieve stability and low distortion. A phase-lock-loop module and a voltage controlled oscillator module insure the correct operating frequency. A power control module insures the correct level of power output at the antenna. The only adjustments are frequency, modulation and power level. No RF tuning of the transmit circuit is required or possible. The maximum multi-frequency switching range is limited only by the ability to control the voltage controlled oscillator frequency. MPR provides a 24 MHz bandwidth with no RF tuning. Practically, the transmit frequency range is limited only by the antenna VSWR.

Two power levels are available in the MPR transmit circuit and are designated by transmit type numbers, KT167 and KT168. KT167 provides 1 to 2.5 watts output while KT168 provides 1 to 6.0 watts output.

The MPR receive circuit is a single conversion circuit using fifth mode oscillator modules to reduce spurious and provide a wide frequency switching range. A 21.4 MHz IF is the standard IF. Alternate IF's of 20.2 MHz and 23 MHz are also available.

There are eight tuning adjustments in the receive circuit, all in the front end. Four of the adjustments are RF helical resonators tuned for maximum receive quieting. The other four adjustments are in the injection frequency multiplier chain. Three of these adjustments are helical resonators tuned for best injection signal. The other adjustment is a slug tuned coil for interstage coupling. There is one metering test point provided for this adjustment.

Two receive circuits are available in the MPR and are designated by receive type numbers ER109 and ER110. The ER109 is a high intermodulation circuit. ER110 is a high sensitivity circuit.

The power supply for the MPR radio is a rechargeable 7.5 VDC battery pack. Two battery packs are available: a 750 mAh capacity and a 1200 mAh capacity, as the application demands. A voltage regulator module supplies a continuous 5.4 VDC and a keyed 5.4 VDC both short circuit protected.

The MPR radio P2B combination consists of eight assemblies plus a battery pack. The MPR radio P2C combination consists of nine assemblies plus a battery pack (See Figure 1). The nine assemblies can easily be disassembled in the field to replace any damaged or defective parts. All parts of similar MPR radios are directly interchangeable.

Radio Assembly

The radio assembly consists of a multi-layered system board and all modules for the transmit, receive, voltage regulation and option circuits.

The system board has four layers of printed wire pattern. The layer on the module side of the board is a ground plane. The layer on the back side of the board is for DC distribution. The two center layers of printed wire pattern are for signal interconnections. Fifty ohm strip line is used for all high frequency connections.

The buried layers of printed wire pattern on the system board limits circuit pattern tracing for troubleshooting, to DC distribution. A technician must rely on the schematic diagram, outline diagram and other troubleshooting aids provided in this manual.

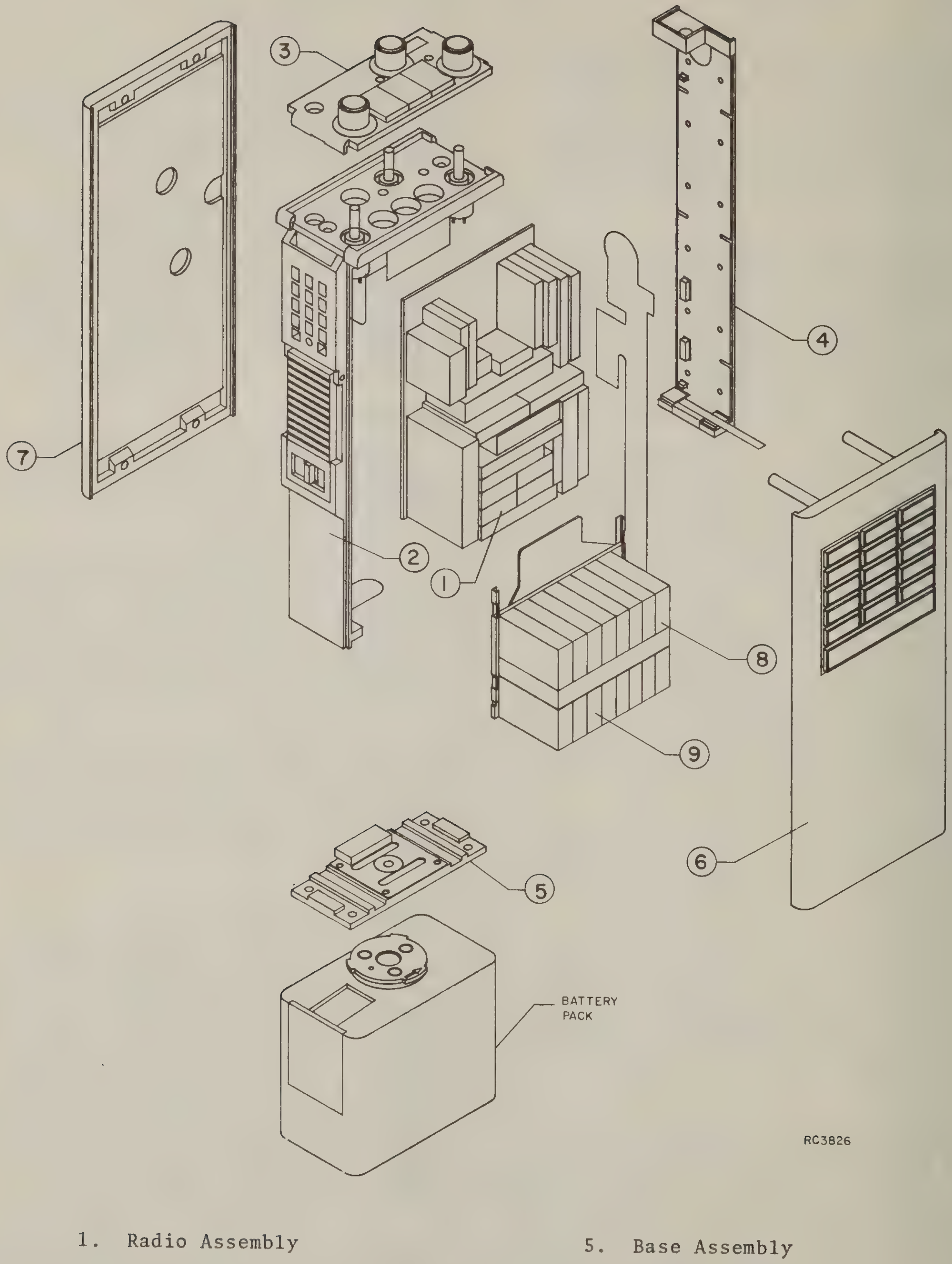
Controller Assembly

The Controller Assembly consists of a BCD channel select switch mounted on the control assembly and connected through a flexible printed wire board to a controller board. Mounted on the controller board is a simple or delux controller module, four transmit oscillator modules and four receive oscillator modules. The simple controller module provides ten oscillator keying leads without the ability to program repeat frequencies. Multiple tone Channel Guard and DPL functions can be programmed from the channel select switch.

The delux controller module provides the ultimate in system control with the ability to fully program repeat oscillators in the receive and transmit mode. Control is also provided for four system options.

Extender Assembly

The Extender Assembly consist of a printed wire board connecting the controller


1
2
3
4
5
6
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8
9
BATTERY PACK
RC3826

1. Radio Assembly
2. Control Assembly
3. Top Cover Assembly
4. Right Side Rail Assembly
5. Base Assembly
6. Front Cover Assembly
7. Back Cover Assembly
8. Controller Assembly
9. Extender Assembly

Figure 1 - MPR Assemblies

board to an oscillator board. The oscillator board extends the RF channel capabilities by providing four additional transmit oscillator modules and four additional receive oscillator modules for P2C combinations.

Control Assembly

The Control Assembly consists of a molded Lexan® side rail, a molded Lexan® top plate and a flexible printed wire board. The side rail provides a UDC accessory jack, PTT Bar, radio power, ON-OFF slide switch and an antenna mounting stud. The top plate provides a volume control, squelch control, a rotary channel select switch and a red LED transmit indicator. Also, provided on the top plate is a rotary switch and three toggle switches plus LED indicators for option control.

The flexible printed wire board is folded around the radio assembly and makes all major interconnections between the radio assembly, UDC accessory jack and all operating controls including option controls. The flexible printed wire board does not make coax power output connections, speaker connections and the PA DC feed jumper.

Many control leads accessible on the flexible printed wire board, can be used to expedite isolation of defective modules.

Top Cover Assembly

The top cover is a decorative molded Lexan® top cap snapped in place over the top plate. When in place, the top cover seals the volume, squelch and option controls against water and provides the proper identification of each control.

Right Side Rail Assembly

The right side rail consists of a molded Lexan® side rail.

Base Assembly

The Base Assembly fastens to the bottom of the MPR housing and provides the female portion of the battery pack fastener. The assembly consists of a die cast base, a stainless steel contact spring, a rubber seal and a contact assembly.

Front Cover Assembly

The Front Cover Assembly fastens to the front of the MPR housing and mounts the system speaker and local microphone. The assembly consists of a die cast aluminum cover, speaker grille, speaker, microphone, a rubber boot for both the speaker and the microphone, providing isolation from vibration, a retaining clip, fastener, standoffs and Ensolite® foam shock pads.

The aluminum front cover assembly provides additional heat sinking for the transmit exciter and PA.

Rear Cover Assembly

The Rear Cover Assembly consists of a rear cover, a thin polyester insulator to prevent projecting sockets from shorting against the rear cover and an Ensolite® foam shock pad, identical to those in the front cover assembly. The rear cover fastens to the four stand-offs in the front cover.

The outside of the rear cover has a stainless steel receptical plate for attaching an optional swivel mount, hand strap or pocket clip. A customer identification plate, a combination nameplate, an FCC compliance statement and an intrinsically safe nameplate may also be present.

Battery Pack Assembly

The Battery Pack Assembly consists of a molded Lexan® case and slide, a stainless steel latch spring, a steel fastener plate, three round contact strips for charging contacts and six nickel-cadmium batteries. A thermistor, diode and fuse is also included in the Battery Pack Assembly. The fuse is accessable from outside the case.

The steel latch spring is operated by the side slide. The side slide on the opposite side of the case is for decorative purposes only.

Assembly

The top plate, control side rail and system board are interconnected by the control side flexible printed wire board. The top plate and controller board are interconnected by the flexible printed wire board on the right side. The oscillator board, if present, is connected to the controller board by the extention flexible printed wire board. This assembly is "folded up" and mounted together with two screws from the top control panel into the two side rail assemblies, and four screws through the base plate assembly into the side rail assemblies. The system board, controller board and oscillator board, if the radio is a P2C combination, are nested between shock pads in the side and base assemblies. After all modules are plugged into the boards, the front and rear covers are fastened together (after connecting the speaker and microphone) with four screws through the rear cover into the four standoffs on the front cover. The Lexan® top cover is snapped on the top of the top plate and knobs are assembled. The antenna is screwed on to the antenna stud and the battery pack attached. The MPR Communication System is now ready for use.

OPERATION

TO RECEIVE A MESSAGE

1. Disable any options by placing the option control toggle switch(es) into a disabling position.

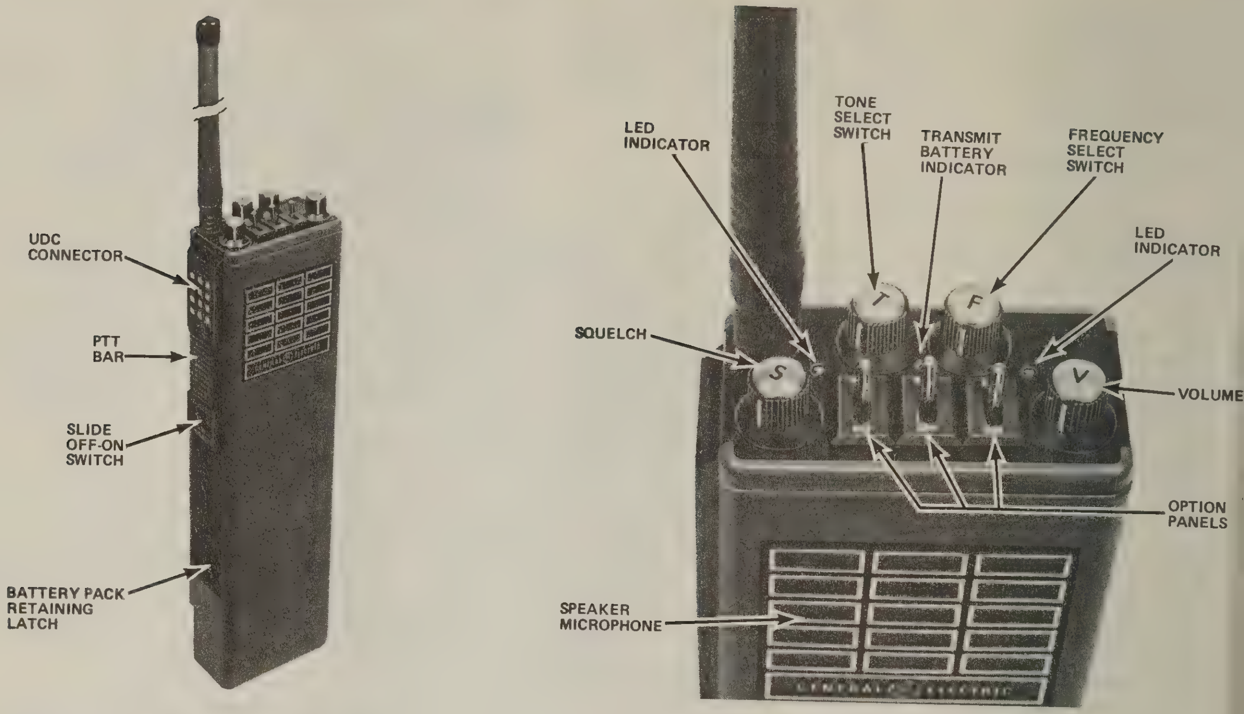

UDC CONNECTOR
PTT BAR
SLIDE OFF-ON SWITCH
BATTERY PACK RETAINING LATCH
LED INDICATOR
TONE SELECT SWITCH
TRANSMIT BATTERY INDICATOR
FREQUENCY SELECT SWITCH
LED INDICATOR
SQUELCH
VOLUME
OPTION PANELS
SPEAKER MICROPHONE
S
T
F
V

Figure 2 - Operating Controls

2. Rotate the volume control to approximately half of its rotation.
3. Rotate the squelch control fully clockwise.
4. Place the slide ON/OFF switch in the ON position. A hissing noise should be heard from the speaker.
5. Adjust the volume control so the noise is easily heard but not annoyingly loud.
6. Rotate the squelch control counterclockwise until the noise just stops. DO NOT rotate the squelch control any further. Too much squelch could prevent receiving messages.
7. Place the option controls back into the ON position.
8. Place the frequency select switch into the desired position. Your MPR receive circuit is now ready to receive messages.

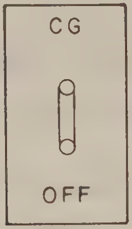
TO SEND A MESSAGE

1. Turn the radio on and select the desired channel as instructed in TO RECEIVE A MESSAGE.
2. LISTEN to insure no one is transmitting on the selected channel. NEVER interrupt another transmission.
3. While holding the radio so the antenna is vertical, press the Push-To-Talk (PTT) bar and speak directly into the Speaker grill or across the face of an external microphone. Use a normal tone of voice. Release the PTT bar as soon as you stop talking. Messages cannot be received when the PTT bar is pressed.

OPTIONS

Channel Guard

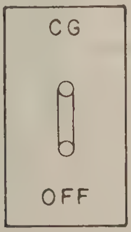
If your radio is equipped with a Channel Guard (CG) option, you have, on the control panel, a two position switch labeled CG-OFF. With the switch in the CG position the decoder permits you to hear only those calls that are tone-coded on your Channel Guard frequency. The encoder permits you to communicate with other radios in your system equipped with Channel Guard decoders, tone-coded on your Channel Guard frequency. Moving the switch to the OFF position permits you to hear all calls on the channel. When sending, with the switch in the OFF position, you will still transmit a Channel Guard tone. Before sending a message, listen or observe the optional LED Carrier activity indicator to insure no one is using the channel.

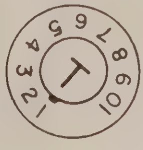


Multiple Tone Channel Guard

If your radio is equipped with a Multiple Tone Channel Guard option, you have, on the control panel, a two position switch labeled CG-OFF and possibly a rotary switch labeled T and graduated 1 through 10. With the two position switch in the CG position, the decoder permits you to hear only those calls tone coded on the Channel Guard frequency selected by the rotary Tone-Select switch. If the Tone select switch is not present, you will hear only those calls tone-coded as pre-programmed on the RF channel selected by the frequency select switch. The encoder permits you to communicate with other radios in your system equipped with Channel Guard decoders. Encoder tone frequencies are also selected by the Tone select switch or pre-programmed on the RF channel selected by the frequency select switch.

Moving the two position switch to the OFF position permits you to hear all calls on the selected channel. When sending, with the switch in the OFF position, you will transmit a Channel Guard tone. Before sending a message, listen or observe the optional LED Carrier activity indicator to insure no one is using the channel.

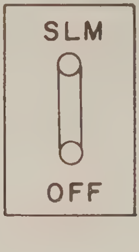




Search Lock Monitor

If your radio is equipped with a Search Lock Monitor (SLM) option, you have, on the top cover, a two-position switch labeled SLM-OFF. With the switch in the SLM position and a signal is not present, the SLM alternately searches between two receive channels and the LED indicator blinks at a fast rate. One of the receive channels is selected by the frequency select switch. The other receive channel is pre-programmed. When a signal is present, the SLM locks on the active channel and the LED indicator stops blinking. When a signal is no longer present, the SLM resumes searching. Before transmitting, the search must be defeated by placing the two-position switch in the OFF position. When the switch is in the OFF position, the radio transmits on or monitors only the channel selected by the frequency select switch.

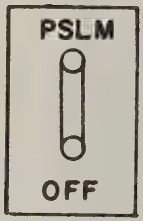
Although search should be defeated before transmitting, the transmit circuit will key on the pre-programmed channel if the two-position switch is in the SLM position.



Priority Search Lock Monitor

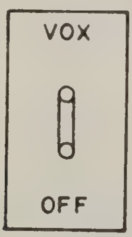
If your radio is equipped with a Priority Search Lock Monitor (PSLM) Option, you have on the top cover, a two-position switch labeled PSLM-OFF. When the switch is in the PSLM position and a signal is not present, the PSLM alternately searches between two receive channels and the LED indicator blinks at a fast rate. One of the receive channels is a pre-programmed priority channel. The other receive channel is selected by the frequency select switch. When a signal is present, the PSLM locks on the active channel. If the active channel is the pre-programmed priority channel the LED indicator lights. If the active channel is the selected non-priority channel, the PSLM continues to search the priority channel while monitoring the non-priority channel. If a signal occurs on the priority channel while monitoring the non-priority channel, the PSLM switches to monitor the priority channel. Before transmitting, the search must be defeated by placing the two-position switch into the OFF position.

When the switch is in the OFF position, the radio transmits on or monitors only the channel selected by the frequency select switch. Although search should be defeat before transmitting, the transmit circuit will key on the priority channel if the two-position switch is in the PSLM position.



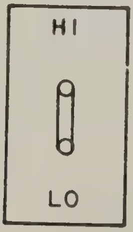
Voice Control

If your radio is equipped with a Voice Control (VC or VOX) option, you have on the top cover, a two-position switch labeled VOX-OFF. With the switch in the VOX position, speaking into the external microphone keys the transmitter. When the switch is in the OFF position speaking into the external microphone will not key the transmitter.



HI/LO Power

If your radio is equipped with a manual HI/LO Power option, you have, on the top cover, a two position switch labeled HI-LO. With the switch in the HI position the RF power output is a maximum. With the switch in the LO position the RF power output is a predetermined reduced power.



Operation with the HI/LO Power switch in the LO position will extend battery life when the higher power output is not necessary for reliable communication.

REPLACEMENT OF BATTERY PACKS

To remove the battery pack from the radio:

1. Turn the radio OFF.
2. Press the battery pack retaining latch toward the battery pack, and turn the battery pack one-quarter turn to the left. The battery pack can now be detached from the radio.

To re-connect the battery pack to the radio:

1. Hold the battery pack at a 90° angle to the radio as shown in Figure 3.
2. Align the large tab marked with an arrow on the battery pack connector with large cut-out on the radio socket.
3. Press the battery pack connector into the socket on the radio and turn the battery pack one-quarter turn to the right until the latch clicks.

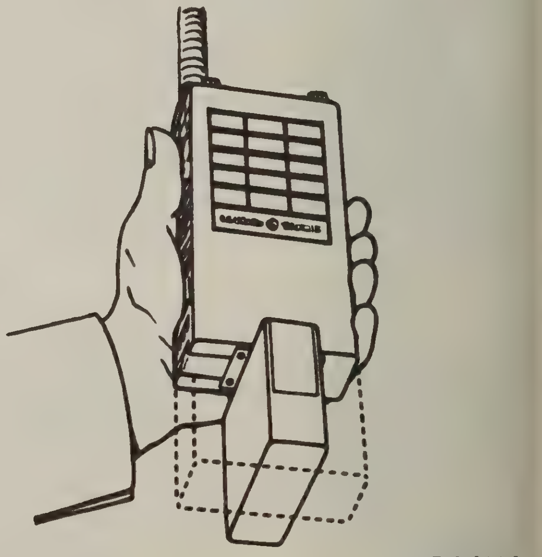


Figure 3 - Battery Pack Replacement

RE-CHARGING BATTERY PACKS

The MPR radio is equipped with a battery pack transmit voltage LED indicator. This indicator blinks rapidly while transmitting with a fresh charged battery pack.

As the battery pack gets weaker, the indicator will blink slower. When the battery pack needs recharging, the indicator will not light.

There are several chargers and charge rates available for charging, the MPR battery packs. For specific instructions refer to the applicable charger Operating Manual.

OPERATING TIPS

The following conditions tend to reduce the effective range of Two-Way radios, and should be avoided whenever possible.

- Operating the radio in low areas of the terrain, or while under power lines or bridges.
- Operating the radio inside of a vehicle, or in a metal or steel-framed building unless using an outside antenna.
- Obstructions such as mountains or buildings between the person sending and the person receiving the messages.

In areas where transmission or reception is poor, some improvement maybe obtained by insuring the antenna is vertical. Moving a few yards in another direction or moving to a higher elevation may also improve communication.

SYSTEM ANALYSIS

General Electric's MPR radio is a completely modularized, two-way, FM communication system, utilizing a multi-layered system board. The system board contains all circuit modules for the transmit, receive, voltage regulation and option circuits. A flexible printed wire board folds around the system board to make all interconnections between the system board and radio controls.

Many control leads, accessible on the flexible printed wire board, can be used to expedite isolation of defective circuit modules. Refer to the Troubleshooting Procedures.

All control leads for the MPR radio are "barred", such as $\overline{\text{PTT}}$ or $\overline{\text{CAS}}$. This means the lead is in a low voltage condition when the function name is true. For example, $\overline{\text{PTT}}$ is low when the radio is keyed. Refer to the Table of Contents for a list of Control leads and a description of their function.

A Signal lead has its name chosen so the function of the lead is obvious, such as:

VOL - DC voltage used to control volume

SQ - DC voltage used to control squelch

DISCR - DC and audio from discriminator

PWR CONT - DC output from power control used to control the transmit gain

Circuit illustrations shown in the following text are simplified representatives of actual circuits. They are intended only to illustrate basic functions.

TRANSMIT CIRCUIT

The MPR transmit circuit, as shown in Figure 4 - Block Diagram, consists of the following integrated circuit modules:

Audio Processor (TX-AA)

Optional Speech Compressor/Voice Control (SC/VC)

Oscillator Module (TX-X0)

Phase-Lock-Loop (PL)

Voltage Controlled Oscillator (VO)

Exciter (EX)

Power Amplifier (PA)

Power Control (PC)

Antenna Relay (RY)

Filter Network (FN)

Audio Processor Module (TX-AA)

The audio processor module provides an audio input designated EXT MIC at Pin 13 for an external microphone and an audio input designated INTL MIC at Pin 14 for an internal microphone (refer to Figure 5). Normally, audio is accepted from the external microphone unless, the $\overline{\text{PTT}}$ lead is in a low voltage condition. The $\overline{\text{PTT}}$ lead in a low voltage condition means the radio has been keyed by the PTT bar on the control side of the radio. Keying the radio with the PTT bar gates off the external microphone and gates on the internal microphone. Microphone gating is typically -55 dB.

Audio from either microphone input is amplified and brought out of the processor at the output designated PRE-AMPL OUT at Pin 9. The audio is jumpered to the input designated AUDIO IN at Pin 6 unless, an optional speech compressor is used. An additional 10 dB of microphone gain can be obtained by connecting a 3.6K resistor in

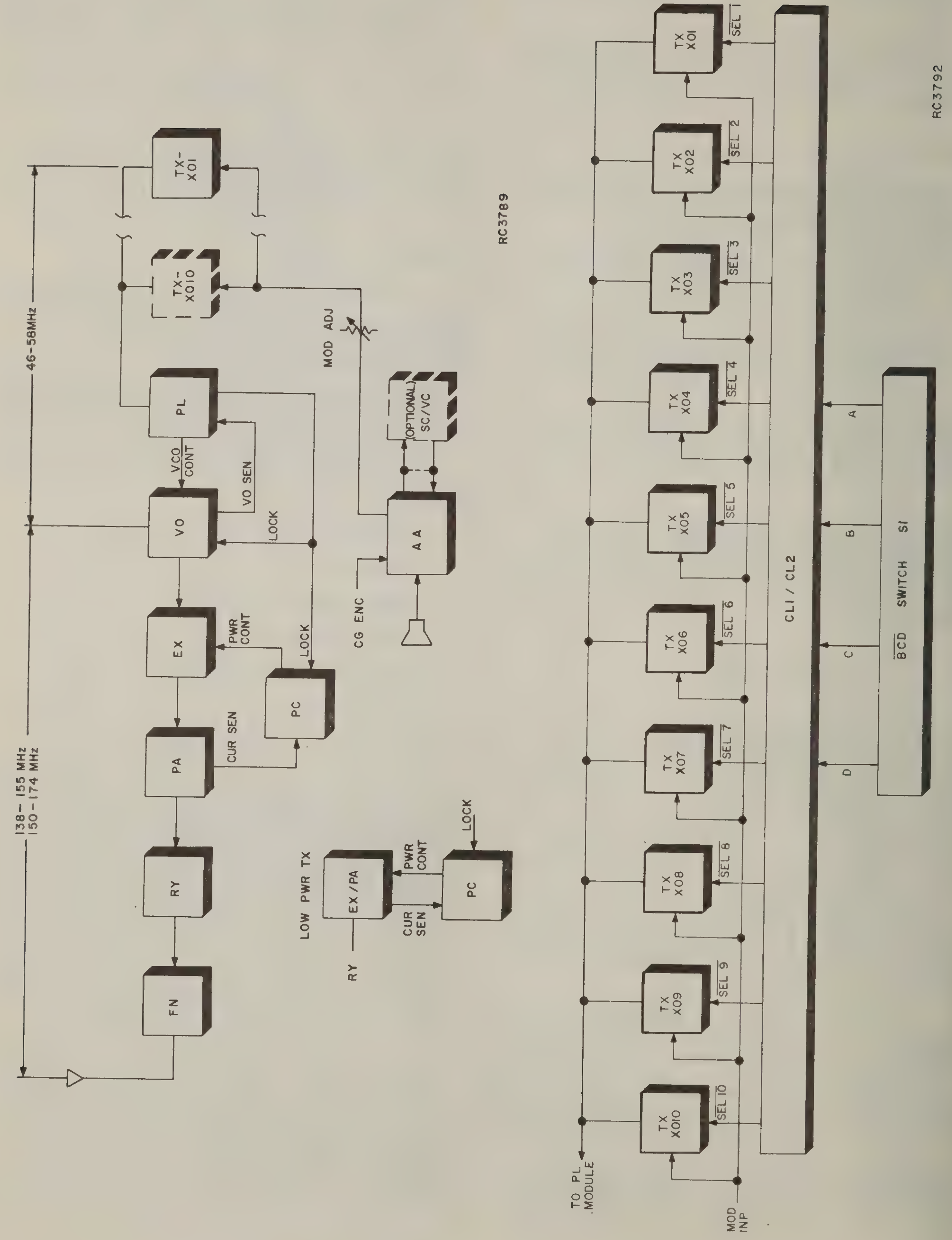

138-155 MHz
150-174 MHz
46-58MHz
TX-XO1
TX-XO10
PL
VCO CONT
VO SEN
VO
LOCK
EX
PWR CONT
LOCK
PC
PA
CUR SEN
RY
FN
MOD ADJ
(OPTIONAL) SC/VC
A A
CG ENC
LOW PWR TX
EX / PA
PWR CONT
PC
LOCK
CUR SEN
RY
RC3789
TX XO1
SEL 1
TX XO2
SEL 2
TX XO3
SEL 3
TX XO4
SEL 4
TX XO5
SEL 5
TX XO6
SEL 6
TX XO7
SEL 7
TX XO8
SEL 8
TX XO9
SEL 9
TX XO10
SEL 10
CL1 / CL2
A
B
C
D
BCD SWITCH S1
TO PL MODULE
MOD INP
RC3792

Figure 4 - Block Diagram

series with a 2.2 mfd tantalum capacitor between the MIC GAIN lead and ground.

Audio jumpered to Pin 6 is connected through an active pre-emphasis amplifier and an active peak-to-peak clipper limiter circuit. The limiter output can be attenuated by more than 60 dB by pulling the lead designated $\overline{\text{MIC MUTE}}$ at Pin 4 to ground. The $\overline{\text{MIC MUTE}}$ lead is used to mute microphone inputs when options are used which transmit data. The output of the limiter circuit is applied to the input of a summing amplifier. The summing amplifier provides two inputs for modulation. One input, designated ENC at Pin 5, is the input for Channel Guard modulation and is added to the fixed output from the limiter circuit. The input, designated TONE INP at Pin 7 is intended for touch tone or optional multiple tone Channel Guard encoders. The output of the summing amplifier passes through an active post limiter filter and out of the processor at the lead designated AUDIO OUT, Pin 2. The output of the audio processor is applied through MOD ADJ pot R904 to the inputs of the Oscillator modules designated AUD INP at Pin 7.

A battery indicator circuit is also part of the audio processor. LED transmit indicator DS701 connects to the audio processor module at the lead designated TX BAT IND at Pin 18. During transmit, the battery pack voltage is measured and the transmit indicator blinks at a rate determined by the voltage under load. A rapidly blinking indicator indicates a fully charged battery pack with the blink rate slowing as the voltage decreases. The indicator will not light when the end of the voltage has been reached and the battery must be recharged.

Optional Speech Compressor Module (SC)

The speech compressor module provides a constant audio input level to the amplifier-limiter circuits in the audio processor module. This input level is typically, 45 millivolts at the threshold of compression, and holds the transmitter deviation approximately 2 to 3 dB into limiting; typically, 3.8 kHz of deviation. The compressor will hold the level constant over a 30 dB increase in level over threshold.

There is no discernable difference in audio quality between a radio with a speech compressor and a radio without. The frequency response of the SC module is flat from 300 to 3000 Hz. The SC module also provides 12 dB of gain below compression, for either external or internal microphones. Audio from Pin 9 of the audio processor module is connected to Pin 8 of the SC module. When the SC module is used, the print wire run between Pin 6 and Pin 9 of the audio processor is cut (Refer to Figure 5).

Keying the transmit circuit applies 5.4 Volts to Pin 9 of the SC module (See Figure 6). Below compression, the SC circuit behaves like an amplifier with 12 dB gain. The output of the AC amplifier is insufficient to cause the DC amplifier to operate. In compression, the AC amplifier output is sufficient to cause the detector and DC amplifier to provide a gain control DC voltage to the attenuator, resulting in

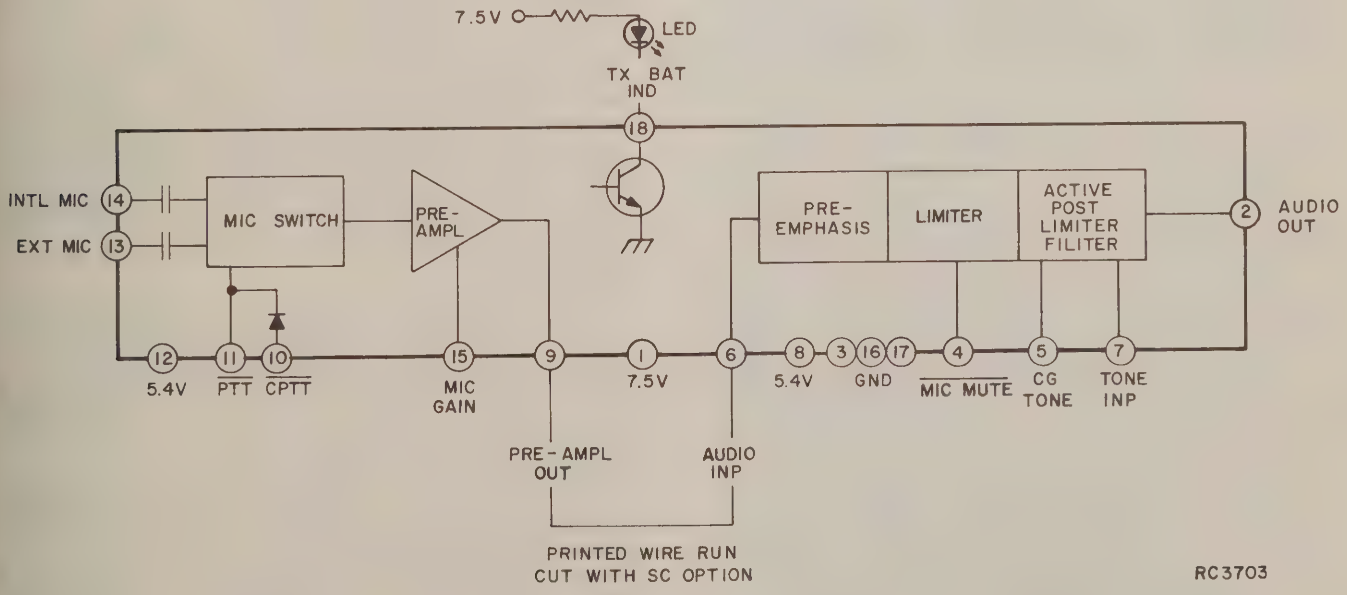


Figure 5 - Audio Processor

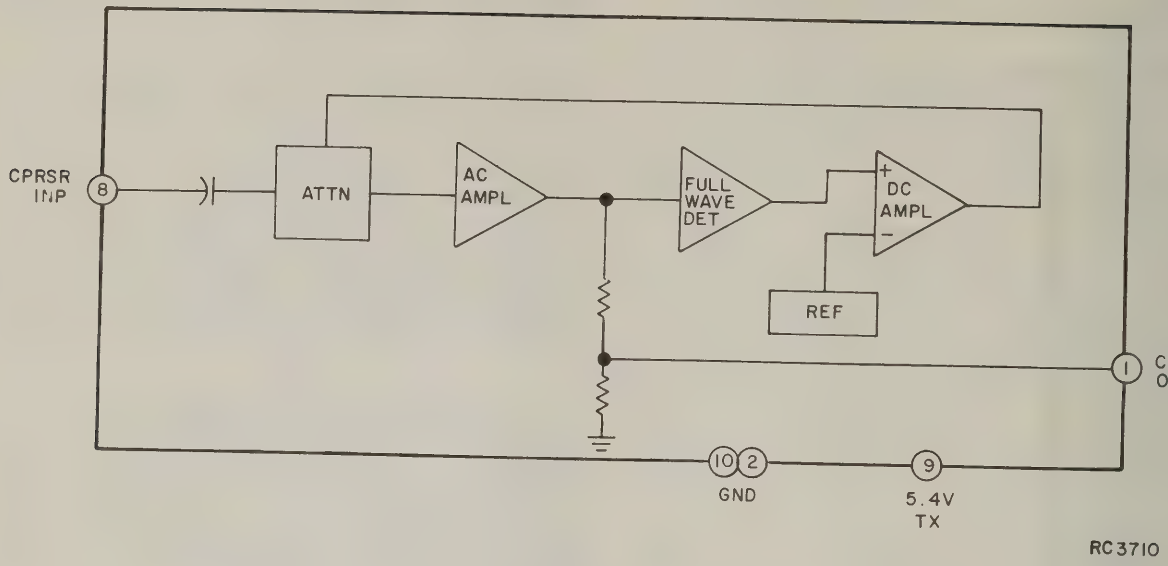


Figure 6 - Speech Compressor

a constant 45 millivolt output on Pin 1. Pin 1 of the SC module is connected to Pin 6 of the audio processor module.

The recovery time for the SC is typically 800 milliseconds.

Optional Voice Control Module (VC or VOX)

The optional voice control module keys the transmit circuit when the operator speaks into the external microphone. To be operational, the VC module must have the Option Control switch in the VOX position and the $\overline{\text{RUS}}$ control lead must be in a high state indicating the receiver is in a squelched condition. This prevents the receive audio from causing the transmit circuit to key.

Audio from Pin 9 of the audio processor module is connected to Pin 8 of the VC module (see Figure 7). The audio is coupled to the input of a selective amplifier. The selective amplifier has a maximum sensitivity of 4.0 millivolts input to the MIC switch at an audio frequency of 650 Hz. This results in a deviation of a 1 kHz when a compressor is not used. The output of the selective amplifier is connected to a rectifier circuit where it is rectified and applied to a switch. If the Option Control switch is in the OFF position and the $\overline{\text{RUS}}$ control lead is high, the DC voltage is connected through the switch to the negative (-) input of a comparator amplifier. When the current flowing through the negative input of the comparator amplifier is greater than the current flowing through the positive (+) input, the output on Pin 4 will pull the $\overline{\text{CPTT}}$ lead low and key the transmit circuit.

The gain of the comparator amplifier and the sensitivity of the VC module is determined by resistor R2102 connected between Pin 7 and system ground. For optimum gain R2102 is 43K. If R2102 were larger, the gain would be greater and if R2102 were smaller, the gain would be less. An acceptable range for R2102 is from 0 ohms to 80K ohms.

The attack time for the VC module is approximately 20 milliseconds. An RC time constant in the comparator amplifier holds the release time at 1 second.

Oscillator Module (TX-X0)

The Oscillator Module is self-contained, FM modulated and fully temperature compensated (See Figure 8). A basic colpitts third mode oscillator circuit operates in the frequency range of 46 to 58 MHz. The output of the oscillator circuit is connected through a cascade common base buffer circuit to Pin 3 of the module. The output is typically one milliwatt into a 400 ohm load.

Temperature compensation for the oscillator circuit is achieved by biasing a voltage variable capacitive diode with a correction voltage. The correction voltage is derived from an "S" shaped correction voltage curve VS temperature.

The module frequency is trimmed using a slug tuned coil molded into the oscillator header providing multi-turn resolution. Audio modulation from the audio processor is DC coupled to Pin 7 of the oscillator module with an input impedance of 120K ohms between Pin 7 and ground.

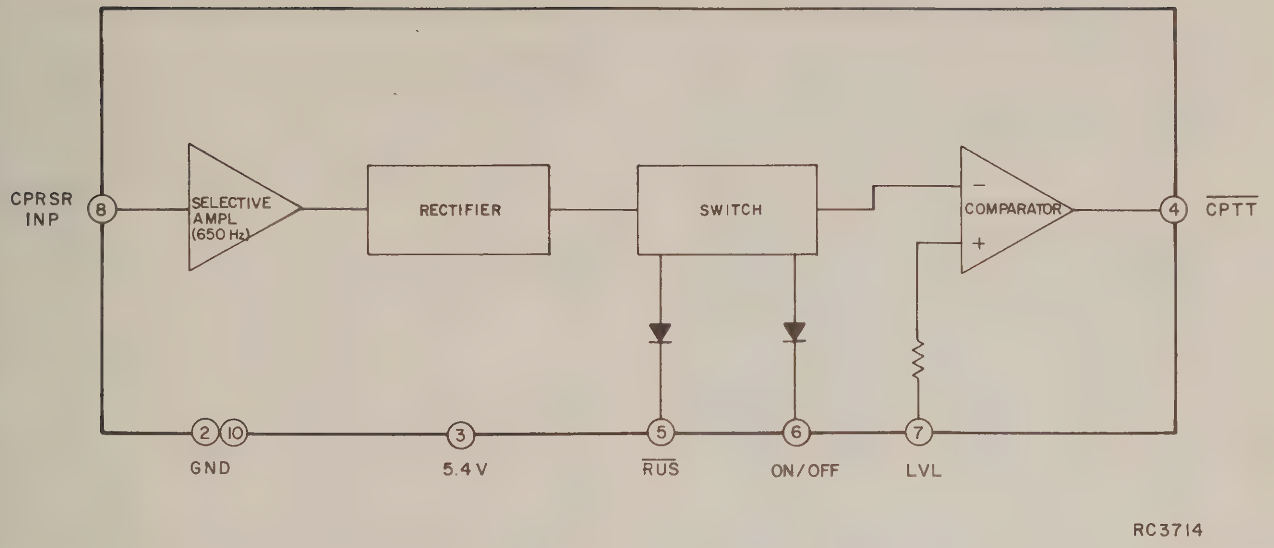
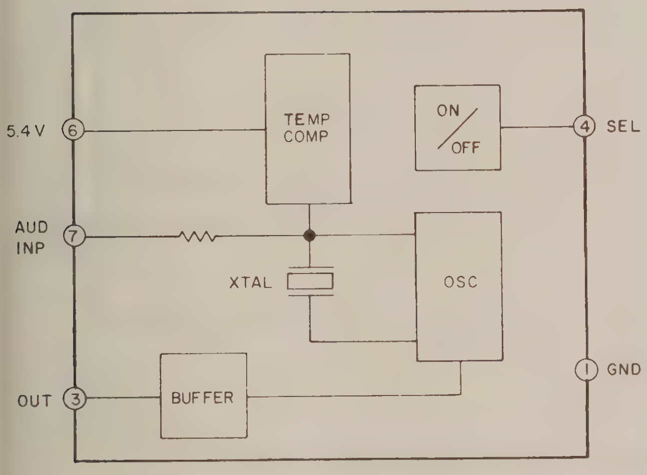


Figure 7 - Voice Control



7.4V TO POWER XO MODULE, SUPPLIED FROM THE PL MODULE, IS ALSO ON PIN 3

RC3704B

Figure 8 - Oscillator Module

The modulation sensitivity is 1.08 Volts/kHz for the third mode oscillator circuit.

The modulated output of the oscillator module is connected to Pin 8 of the phase lock loop module.

Phase Lock Loop Module (PL) and Voltage Controlled Oscillator Module (VO)

The phase lock loop module and the voltage controlled oscillator module using the transmit oscillator frequency as a reference, generates and controls the transmit RF carrier.

Initially, when the transmit circuit is keyed, a ramp generator circuit in the PL module applies a ramp voltage from Pin 4 of the PL module to Pin 3 of the VO module (See Figure 9). This voltage causes a FET oscillator in the VO module to sweep across the entire frequency range of the split. The frequency output of the VO module is looped back from Pin 5 to Pin 6 of the PL module, where it is amplified, divided by three and applied to a phase detector circuit. The reference frequency from the transmit oscillator circuit is connected to pin 8 of the PL module and is also applied to the phase detector circuit. When the reference frequency from the transmit oscillator and the VO frequency are the same, the phase detector circuit shuts the ramp generator down. DC voltage from the phase detector (2 to 5 volts DC) completes the loop back from Pin 4 of the PL module to Pin 3 of the VO module, holding the RF carrier at exactly the third harmonic of the reference frequency. Simultaneously the phase detector circuit pulls the $\overline{\text{UNLOCK}}$ lead to a high voltage state. The $\overline{\text{UNLOCK}}$ lead is connected from Pin 2 of the PL module to Pin 1 of the VO module and Pin 1 of the Power Control Module (PC). When the $\overline{\text{UNLOCK}}$ lead goes high, a gate in the VO module opens allowing a minimum of 50 milliwatts of RF drive to be applied from Pin 9, of the VO module, to Pin 11 of the transmit Exciter module (EX).

The $\overline{\text{UNLOCK}}$ lead high, on Pin 1 of the PC module, turns on the supply voltage to enable the first stage in the EX or EX/PA.

The complete phase lock occurs, typically, within five milliseconds from the activation of the PTT bar.

If at any time the phase lock loop should break lock, the transmit output will immediately be inhibited by the phase

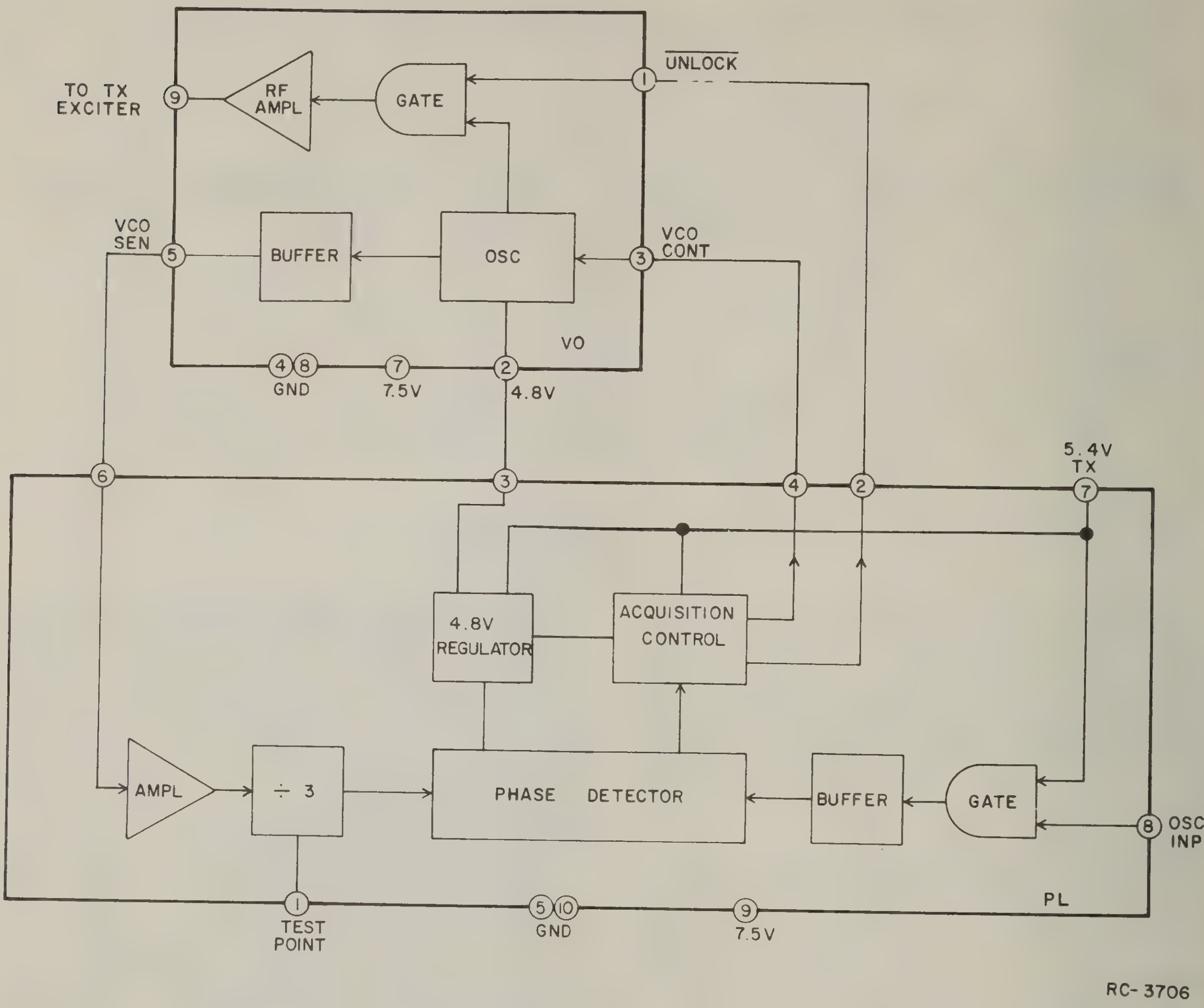

TO TX EXCITER
9
RF AMPL
GATE
1
UNLOCK
VCO SEN
5
BUFFER
OSC
3
VCO CONT
VO
4
8
GND
7
7.5V
2
4.8V
5.4V TX
6
3
4
2
7
4.8V REGULATOR
ACQUISITION CONTROL
AMPL
÷ 3
PHASE DETECTOR
BUFFER
GATE
8
OSC INP
1
TEST POINT
5
10
GND
9
7.5V
PL
RC-3706

Figure 9 - Phase Lock Loop and Voltage Controlled Oscillator

detector, pulling the $\overline{\text{UNLOCK}}$ lead to a low state.

If a transmit oscillator module should fail, the phase detector will continue sweeping the VO module, but will not enable the transmit output stages.

Exciter Module (EX)

The EX module is a two stage RF amplifier module with an input and output impedance of 50 ohms. The first stage has its DC power supplied by the Power Control Module (PC).

The 50 milliwatts of RF drive from Pin 9 of the VO module to Pin 11 of the EX module is coupled to the input of the first RF amplifier stage (See Figure 10). The first RF amplifier stage amplifies the 50 milliwatts to approximately 550 milliwatts. The output of the first RF amplifier stage is connected to the input of the second RF amplifier stage. The second RF amplifier stage amplifies the 550 milliwatts to approximately 1.8 watts (1.5 watts minimum). The 1.8 watts output from Pin 1 of the EX module is connected to Pin 8 of the Power Amplifier Module (PA).

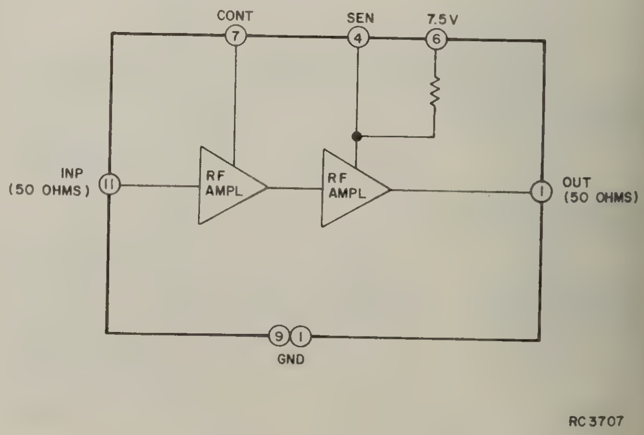

CONT
7
SEN
4
7.5V
6
INP (50 OHMS)
11
RF AMPL
RF AMPL
1
OUT (50 OHMS)
9
1
GND
RC3707

Figure 10 - Exciter

Exciter/Power Amplifier Module (EX/PA)

The EX/PA module is used in low power applications and is identical, except for the output stage, to the EX module. The output RF amplifier stage, in the EX/PA module, amplifies the 550 milliwatts on its input to, typically, 3.0 watts (2.5 watt minimum).

A current sensing metering resistor is in the DC power feed of output stage for the Power Control Module (PC).

Power Amplifier Module (PA)

The PA module is single stage RF amplifier module and like the exciter module has an input and output impedance of 50 ohms. The RF power output from Pin 1 of the EX module is connected to Pin 8 of the PA module where it is applied to the input of the RF power amplifier stage (See Figure 11).

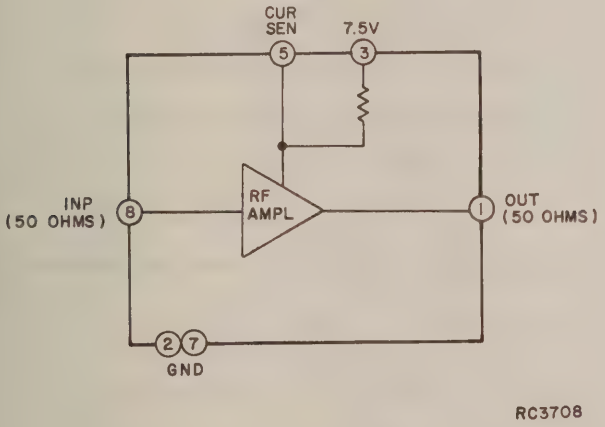


Figure 11 - Power Amplifier

The RF power amplifier stage amplifies the 1.8 watt input from the EX module to a minimum power output level of 6.5 watts at Pin 1. The output at Pin 1 is connected through the antenna relay (RY) to Pin 1 of the filter network module (FN).

Power Control Module (PC)

The RF power output of the MPR radio is regulated by sensing variations in the current drain of the transmit final PA module to control the supply voltage of an earlier driver stage. Supply voltage cannot be applied to the driver stage until the transmit circuit is keyed, applying 5.4 volts to Pin 5 of the PC module. Also, the $\overline{\text{UNLOCK}}$ lead at Pin 1 of the PC module must be high, indicating that the VO is running on the correct operating frequency.

When the transmit circuit is keyed, the output of a reference generator, determined by the HI and LO power adjust controls, is applied to the positive (+) input of a comparator amplifier (See Figure 12). The current sensing element in the final PA module is connected to Pin 7 of the PC module and to the negative (-) input of the comparator amplifier. The amplifier is enabled when the $\overline{\text{UNLOCK}}$ lead goes high. Until then, the output of the amplifier is high and the series regulator is held off. When the $\overline{\text{UNLOCK}}$ lead goes high, the output of the amplifier goes low causing the series regulator to conduct and apply maximum supply voltage to the driver stage.

As the PA module begins to draw more current and the power increases, the changing voltage drop across the sensing element causes the series regulator circuit to regulate the supply voltage to maintain constant current flow through the PA module and constant RF power output.

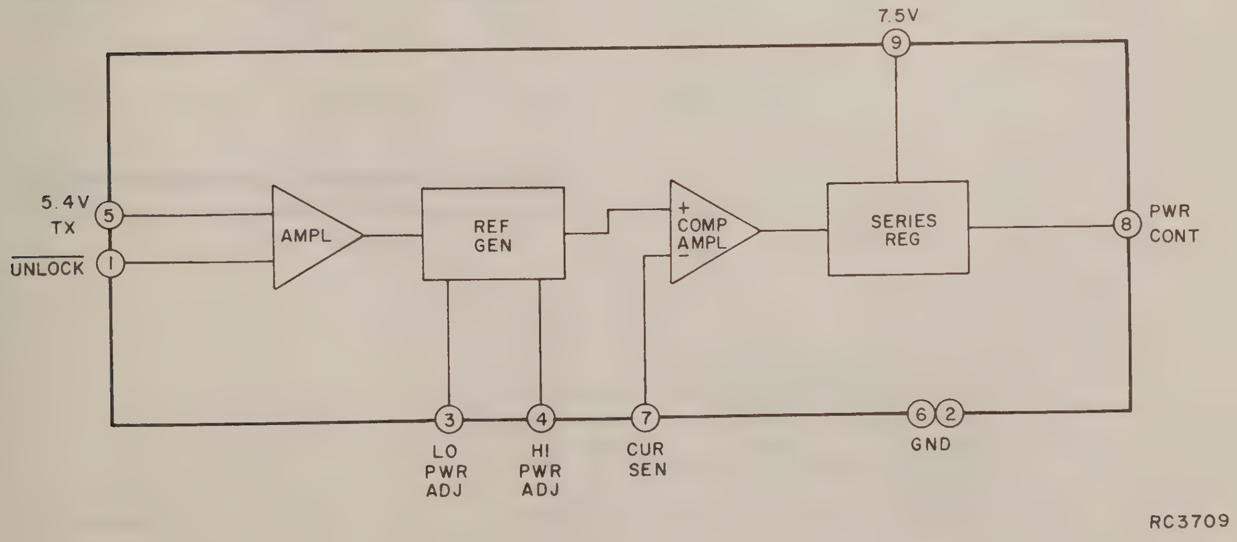


Figure 12 - Power Control

Filter Network Module (FN)

The output of the EX/PA module or the output of the PA module is connected to Pin 1 of the filter network module (FN). The FN module is a passive L/C general parameter low pass filter with an insertion loss of less then .4 dB in the pass band range of 138 - 174 MHz. It also has a rejection of greater than 45 dB in the stop band range of 276 - 1740 MHz. The output of the FN module on Pin 7 is connected to the system antenna.

Optional Carrier Controlled Timer (CT)

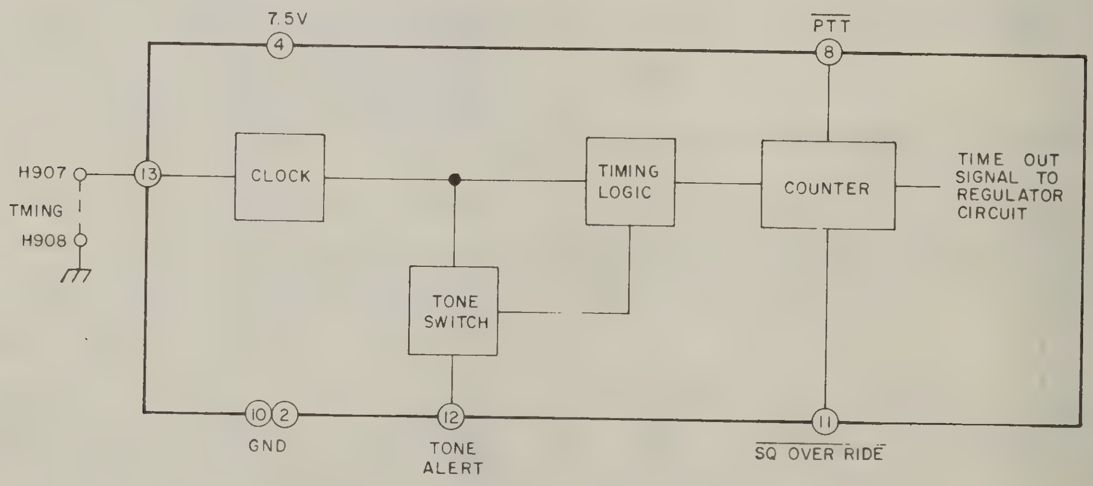
The carrier controlled timer module provides a transmit interrupt, 30 seconds after the transmit circuit has been keyed. Other time periods of 60 or 90 seconds can be obtained by replacing the printed run between H907 and H908, on the system board, with a resistor (See Figure 13).

Keying the transmit circuit causes the PTT lead on Pin 8, of the CT module to go low and start the time-out timing sequence. When the time period for the transmit interrupt has elapsed, a time-out signal to the regulated circuit unkeys the transmit circuit. The SQ OVER RIDE lead on Pin 11, of the CT module, will go low, defeating the receive squelch circuit and opening the receive audio. A DC voltage on Pin 12, of the CT module, will mute the receive audio and an alert tone, also on Pin 12 of the CT module, will be applied to the receiver audio. The alert tone will be heard from the speaker as long as the PTT bar is pressed. A momentary release of the PTT bar resets the CT module.

RECEIVE CIRCUIT

The MPR receive circuit, as shown in Figure 14 consist of the following integrated circuit modules:

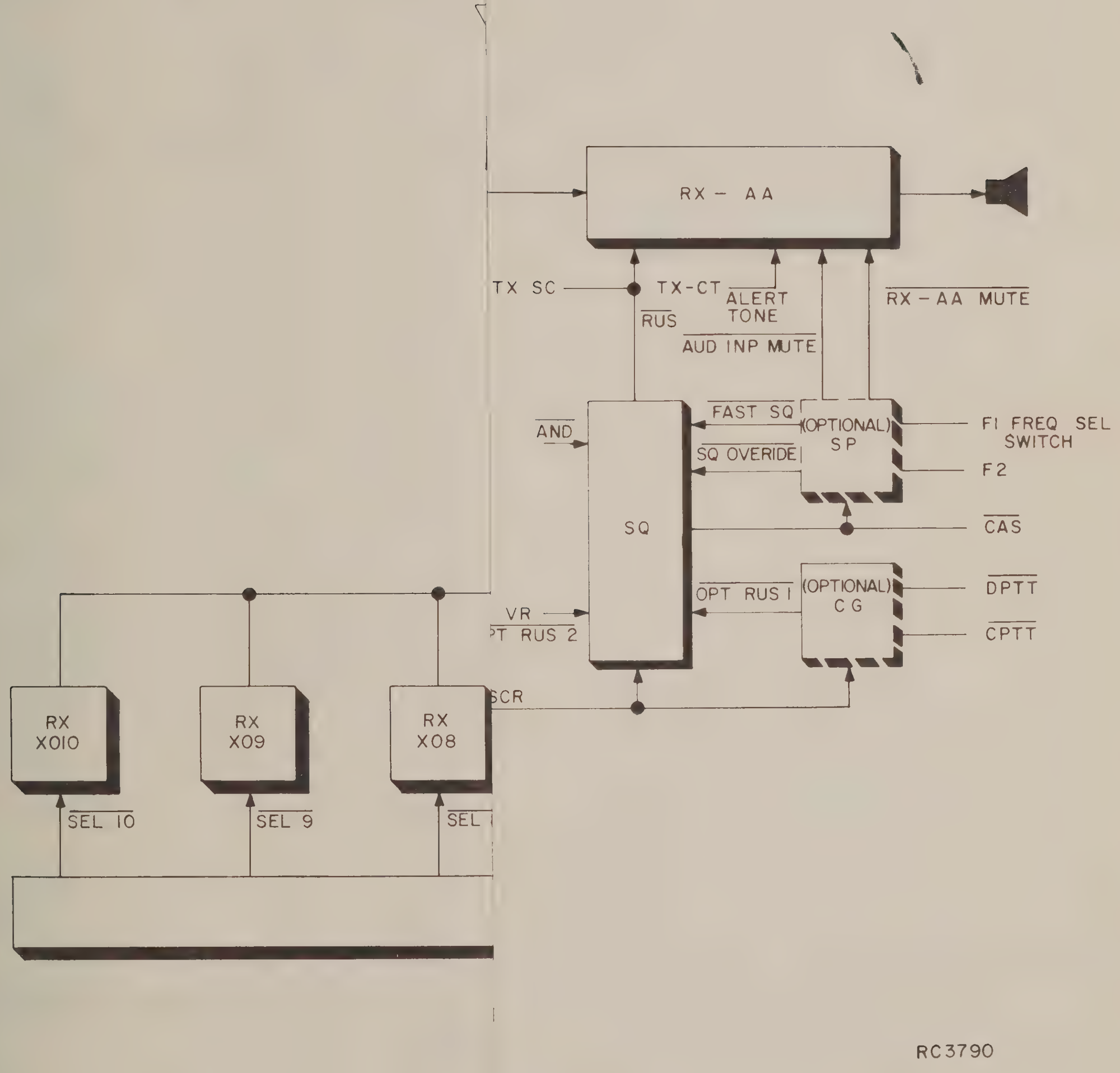
- Oscillator Module(s) (RX-XO)
- Frequency Multiplier Module (FX)
- Filter Network (RX-FN)
- Optional RF Preamplifier Module (RA)
- Receive Converter Module (RC)
- IF Pre-amplifier Module (IA-1)
- IF Amplifier Module (IA-2)
- Crystal Discriminator Module (XD)
- Audio Amplifier Module (RX-AA)
- Squelch Module (SQ)
- Optional Channel Guard Module (CG)
- Optional Search Lock Monitor Module (SP)



TMING	RESISTOR VALUE CONNECTED BETWEEN H907 AND H908	GE PART NO
60 SECONDS	430K	3R151F434J
90 SECONDS	820K	3R151P824J

RC3723A

Figure 13 - Carrier Controlled Timer


RX – AA
TX SC
TX-CT
ALERT TONE
RUS
AUD INP MUTE
RX – AA MUTE
AND
FAST SQ
(OPTIONAL) SP
F1 FREQ SEL SWITCH
SQ OVERIDE
F2
SQ
CAS
OPT RUS 1
(OPTIONAL) CG
DPTT
VR
PT RUS 2
CPTT
SCR
RX X010
RX X09
RX X08
SEL 10
SEL 9
SEL
RC3790

Filter Network Module (FN)

The output of the EX/PA module or the output of the PA module is connected to Pin 1 of the filter network module (FN). The FN module is a passive L/C general parameter low pass filter with an insertion loss of less then .4 dB in the pass band range of 138 - 174 MHz. It also has a rejection of greater than 45 dB in the stop band range of 276 - 1740 MHz. The output of the FN module on Pin 7 is connected to the system antenna.

Optional Carrier Controlled Timer (CT)

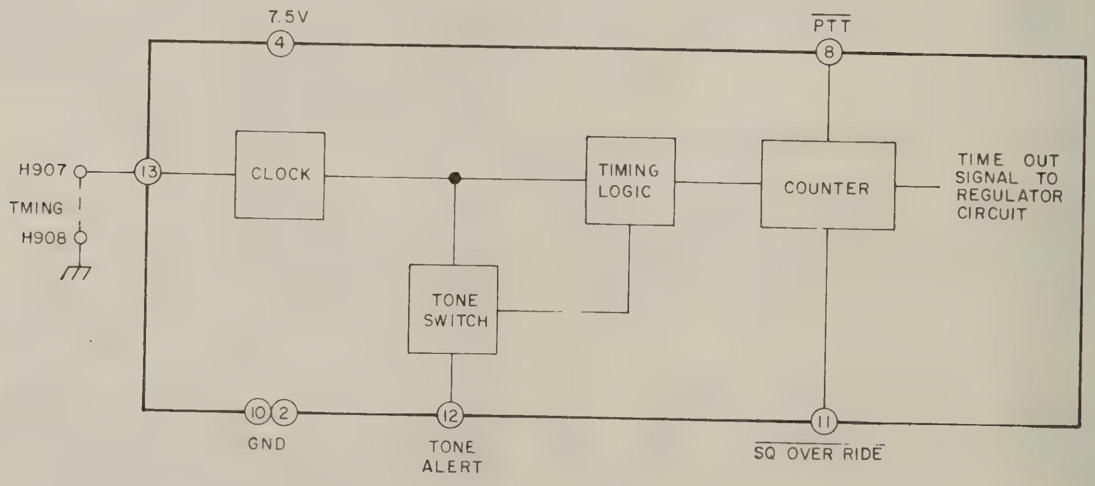
The carrier controlled timer module provides a transmit interrupt, 30 seconds after the transmit circuit has been keyed. Other time periods of 60 or 90 seconds can be obtained by replacing the printed run between H907 and H908, on the system board, with a resistor (See Figure 13).

Keying the transmit circuit causes the $\overline{\text{PTT}}$ lead on Pin 8, of the CT module to go low and start the time-out timing sequence. When the time period for the transmit interrupt has elapsed, a time-out signal to the regulated circuit unkeys the transmit circuit. The $\overline{\text{SQ OVER RIDE}}$ lead on Pin 11, of the CT module, will go low, defeating the receive squelch circuit and opening the receive audio. A DC voltage on Pin 12, of the CT module, will mute the receive audio and an alert tone, also on Pin 12 of the CT module, will be applied to the receiver audio. The alert tone will be heard from the speaker as long as the PTT bar is pressed. A momentary release of the PTT bar resets the CT module.

RECEIVE CIRCUIT

The MPR receive circuit, as shown in Figure 14 consist of the following integrated circuit modules:

- Oscillator Module(s) (RX-XO)
- Frequency Multiplier Module (FX)
- Filter Network (RX-FN)
- Optional RF Preamplifier Module (RA)
- Receive Converter Module (RC)
- IF Pre-amplifier Module (IA-1)
- IF Amplifier Module (IA-2)
- Crystal Discriminator Module (XD)
- Audio Amplifier Module (RX-AA)
- Squelch Module (SQ)
- Optional Channel Guard Module (CG)
- Optional Search Lock Monitor Module (SP)



TMING	RESISTOR VALUE CONNECTED BETWEEN H907 AND H908	GE PART NO
60 SECONDS	430K	3R151F434J
90 SECONDS	820K	3R151P824J

RC3723A

Figure 13 - Carrier Controlled Timer

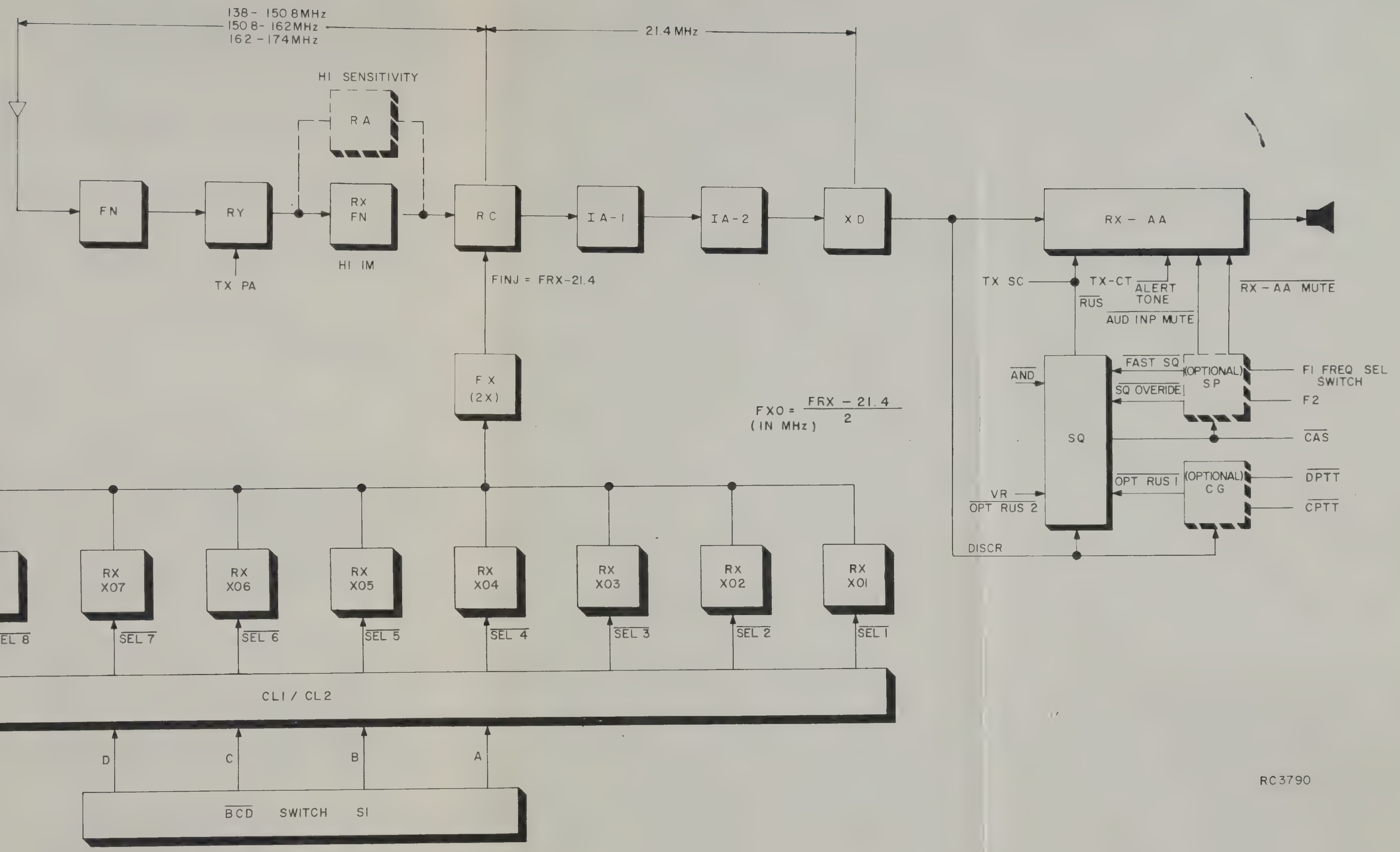
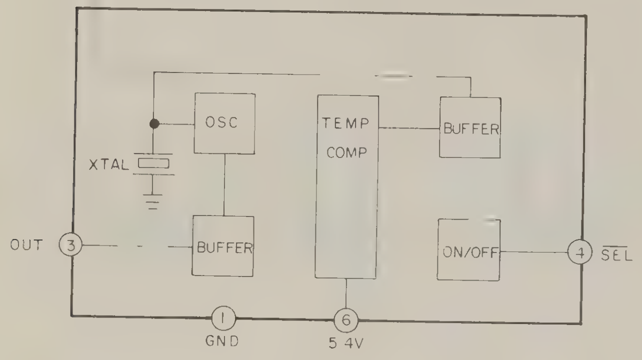

138- 150.8MHz
150.8- 162MHz
162 -174MHz
21.4 MHz
HI SENSITIVITY
RA
FN
RY
RX FN
RC
IA-1
IA-2
XD
RX - AA
TX PA
HI IM
FINJ = FRX-21.4
FX (2X)
FXO = (FRX - 21.4)/2 (IN MHz)
TX SC
TX-CT
RUS
ALERT TONE
AUD INP MUTE
RX - AA MUTE
AND
FAST SQ
SQ OVERIDE
(OPTIONAL) SP
F1 FREQ SEL SWITCH
F2
SQ
CAS
OPT RUS 1
(OPTIONAL) CG
DPTT
CPTT
VR
OPT RUS 2
DISCR
RX XO10
RX XO9
RX XO8
RX XO7
RX XO6
RX XO5
RX XO4
RX XO3
RX XO2
RX XO1
SEL 10
SEL 9
SEL 8
SEL 7
SEL 6
SEL 5
SEL 4
SEL 3
SEL 2
SEL 1
CL1 / CL2
D
C
B
A
BCD SWITCH S1
RC3790

Figure 14 - Block Diagram

Oscillator Module (RX-XO)

The oscillator module is self-contained and fully temperature compensated (See Figure 15). A basic colpitts fifth mode oscillator circuit operates in the frequency range of 53 to 76 MHz. The output of the oscillator circuit is connected through a cascade common base buffer circuit to Pin 3 of the module. The output is typically 1 milliwatt.



7.4V TO POWER XO MODULE,
SUPPLIED FROM THE PL MODULE,
IS ALSO ON PIN 3

RC3738A

Figure 15 - RX Oscillator

Temperature compensation for the oscillator circuit is achieved by biasing a voltage variable capacitive diode with a correction voltage. The correction voltage is derived from a "S" shaped, correction voltage vs temperature curve.

The frequency of the oscillator module is trimmed using a slug tuned coil molded into the oscillator header providing a multi-turn resolution.

The output of the oscillator module is connected to Pin 3 of the frequency multiplier module (FX).

Frequency Multiplier Module (FX)

The frequency multiplier module doubles the oscillator frequency. The oscillator frequency on Pin 3 of the multiplier module is amplified and multiplied by a buffer and multiplier stage (See Figure 16). A slug tuned coil molded into the header of the module provides interstage matching. A test point is provided for this adjustment. Three helical resonators provide output filtering of the +7 dBm injection signal to the receiver converter module (RC).

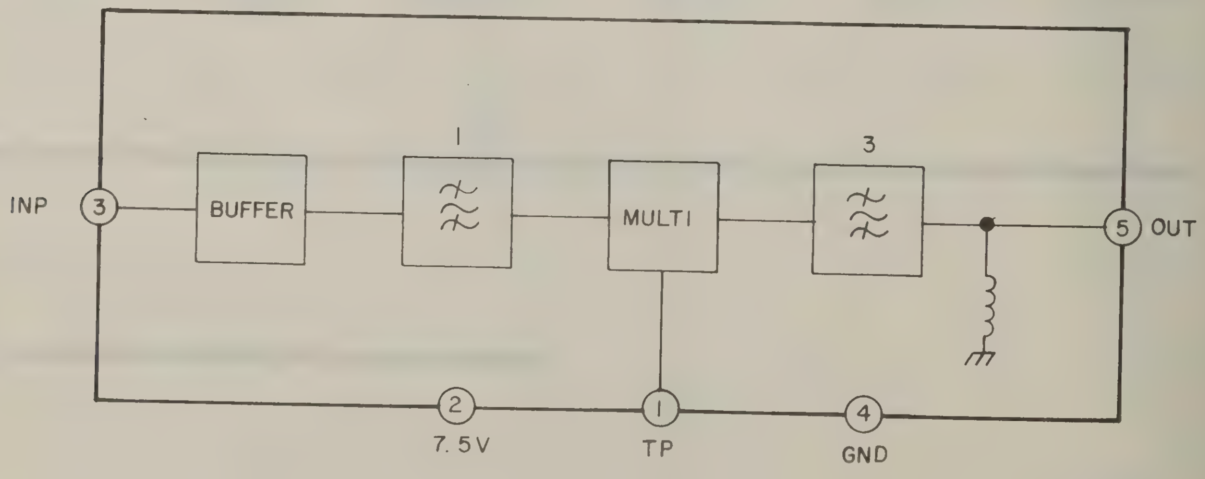
Optional RF Rre-amplifier Module (RA)

The optional RF pre-amplifier module is used in the high sensitivity receive circuit, type ER110, to provide an additional 10 dB of RF gain.

RF from the antenna is coupled through transmit low-pass filter FN and antenna relay RY to the input of the RA module (See Figure 17). The transmit low-pass filter is used in the receive circuit because of the 3rd module response of the helical resonators in the Receive Converter module.

The low-pass filter also provides additional selectivity for the receive circuit.

A bandpass filter in the RA module insures image and spurious rejection. Both input and output of the RA module have an impedance of 50 ohms. The output of the RA module is coupled through a buried 50 ohm stripline, on the system board, to the input of the Receive Converter Module (RC).



RC3739

Figure 16 - Frequency Multiplier

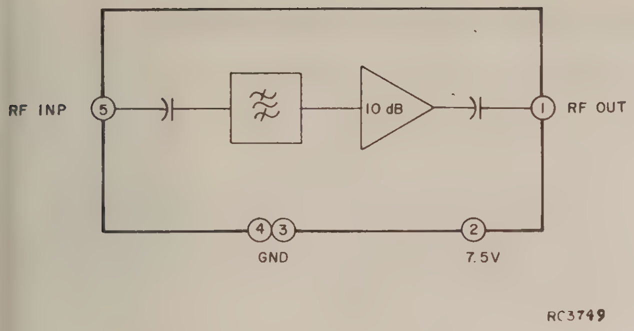


Figure 17 - RF Pre-amplifier

Filter Network Module (RX-FN)

The filter network module replaces the RA module in the high-intermodulation (HI-IM) receive circuit, type ER109. This module is used to reject IF spurs.

Receive Converter Module (RC)

The receive converter module contains four helical resonators, tuned for best receive circuit quieting, and a passive, doubly balanced, diode mixer circuit mounted in a plated zinc casting (See Figure 18). The 138-174 MHz RF signal on the RF input of the RC module and the 116.6-152.6 MHz low side injection frequency on the injection frequency input provides a difference of 21.4 MHz as an IF on the output. The RC module has a typical conversion loss of 9 dB between the RF input and the IF output. All inputs and the IF output of the RC module have 50 ohm impedances. The +7 dBm injection level provided by the FX module is connected to the injection frequency input of the RC module through a buried 50 ohm stripline.

The output of the RC module is connected to the input of IF pre-amplifier module (IA-1).

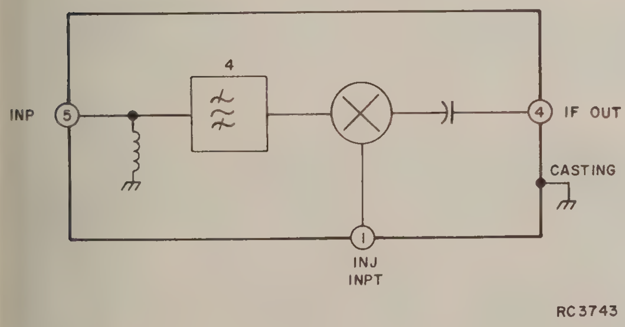


Figure 18 - Receive Converter

IF Pre-amplifier Module (IA-1)

The IF Pre-amplifier module contains an amplifier circuit and a four pole crystal filter (See Figure 19). The 21.4 MHz IF signal from the RC module feeds the input of an amplifier stage providing a 15 dB power gain. The 21.4 MHz IF is connected through the crystal filter with the output on Pin 1. The IA-1 module has an input impedance of 50 ohms and an output impedance of approximately 1200 ohms. The output of the IA-1 module is connected to the input of IF amplifier module IA-2.

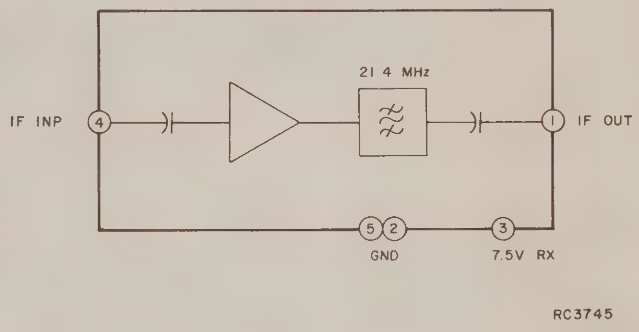


Figure 19 - IF Amplifier

IF Amplifier Module (IA-2)

IF Amplifier module IA-2 contains a 45 dB power gain stage and a 4-pole crystal filter. Input and output impedances of this module are approximately 1200 ohms. The input to the IA-2 module is fed from the output of the IA-1 module. Both input and output pins of the IA-2 module are AC coupled, with the output driving the crystal discriminator module (XD).

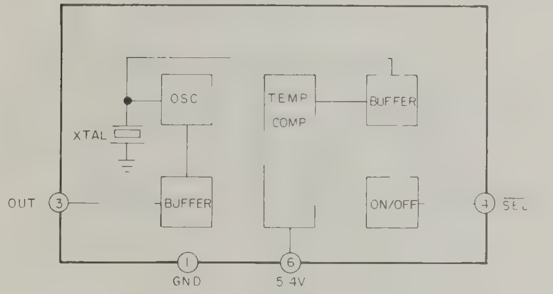
Crystal Discriminator Module (XD)

The crystal discriminator module contains two additional IF amplifier stages for an added 90 dB gain. The discriminator module also contains a crystal resonator, audio detector circuit and audio amplifier circuit (See Figure 20). The 21.4 MHz IF input is connected to the input of the IF amplifier stages for gain and limiting. The output of the amplifier stages is connected through the crystal resonator to the audio detector circuit.

The recovered audio from the detector circuit is amplified, buffered and drives the DISC output lead. This lead feeds the audio to the squelch, audio, and optional tone modules. A typical audio level of 200 millivolts rms is achieved with a 3 kHz deviation at an audio frequency of 1 kHz. The frequency response is flat within ±1 dB over the useful audio range of 70-3000 Hz.

Oscillator Module (RX-XO)

The oscillator module is self-contained and fully temperature compensated (See Figure 15). A basic colpitts fifth mode oscillator circuit operates in the frequency range of 53 to 76 MHz. The output of the oscillator circuit is connected through a cascade common base buffer circuit to Pin 3 of the module. The output is typically 1 milliwatt.



7.4V TO POWER XO MODULE, SUPPLIED FROM THE PL MODULE, IS ALSO ON PIN 3

RC3738A

Figure 15 - RX Oscillator

Temperature compensation for the oscillator circuit is achieved by biasing a voltage variable capacitive diode with a correction voltage. The correction voltage is derived from a "S" shaped, correction voltage vs temperature curve.

The frequency of the oscillator module is trimmed using a slug tuned coil molded into the oscillator header providing a multi-turn resolution.

The output of the oscillator module is connected to Pin 3 of the frequency multiplier module (FX).

Frequency Multiplier Module (FX)

The frequency multiplier module doubles the oscillator frequency. The oscillator frequency on Pin 3 of the multiplier module is amplified and multiplied by a buffer and multiplier stage (See Figure 16). A slug tuned coil molded into the header of the module provides interstage matching. A test point is provided for this adjustment. Three helical resonators provide output filtering of the +7 dBm injection signal to the receiver converter module (RC).

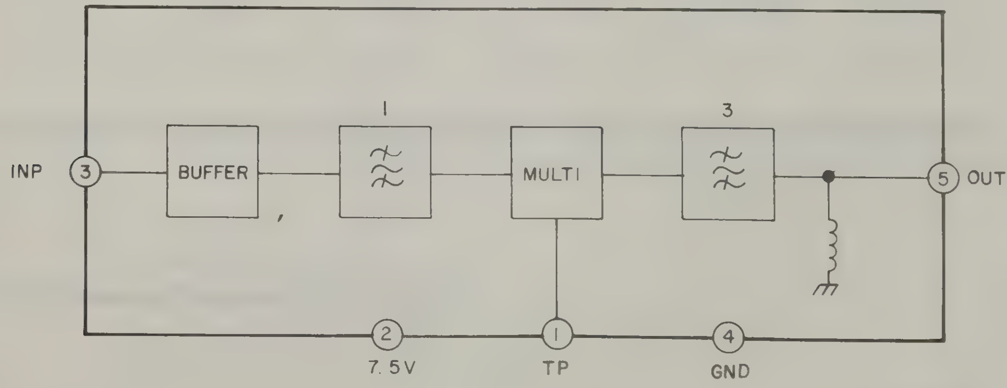
Optional RF Rre-amplifier Module (RA)

The optional RF pre-amplifier module is used in the high sensitivity receive circuit, type ER110, to provide an additional 10 dB of RF gain.

RF from the antenna is coupled through transmit low-pass filter FN and antenna relay RY to the input of the RA module (See Figure 17). The transmit low-pass filter is used in the receive circuit because of the 3rd module response of the helical resonators in the Receive Converter module.

The low-pass filter also provides additional selectivity for the receive circuit.

A bandpass filter in the RA module insures image and spurious rejection. Both input and output of the RA module have an impedance of 50 ohms. The output of the RA module is coupled through a buried 50 ohm stripline, on the system board, to the input of the Receive Converter Module (RC).



RC3739

Figure 16 - Frequency Multiplier

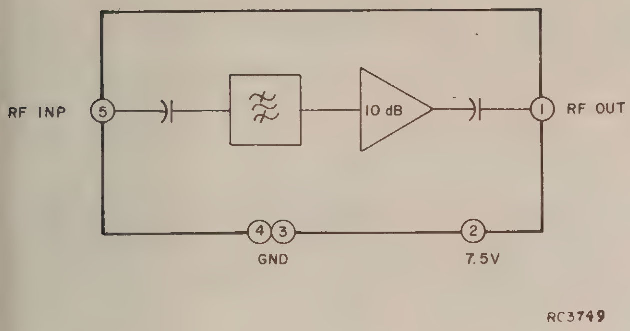


Figure 17 - RF Pre-amplifier

Filter Network Module (RX-FN)

The filter network module replaces the RA module in the high-intermodulation (HI-IM) receive circuit, type ER109. This module is used to reject IF spurs.

Receive Converter Module (RC)

The receive converter module contains four helical resonators, tuned for best receive circuit quieting, and a passive, doubly balanced, diode mixer circuit mounted in a plated zinc casting (See Figure 18). The 138-174 MHz RF signal on the RF input of the RC module and the 116.6-152.6 MHz low side injection frequency on the injection frequency input provides a difference of 21.4 MHz as an IF on the output. The RC module has a typical conversion loss of 9 dB between the RF input and the IF output. All inputs and the IF output of the RC module have 50 ohm impedances. The +7 dBm injection level provided by the FX module is connected to the injection frequency input of the RC module through a buried 50 ohm stripline.

The output of the RC module is connected to the input of IF pre-amplifier module (IA-1).

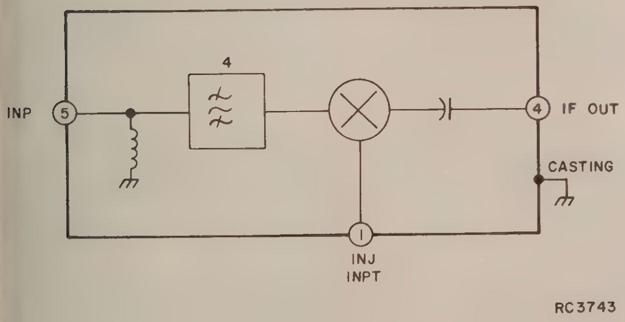


Figure 18 - Receive Converter

IF Pre-amplifier Module (IA-1)

The IF Pre-amplifier module contains an amplifier circuit and a four pole crystal filter (See Figure 19). The 21.4 MHz IF signal from the RC module feeds the input of an amplifier stage providing a 15 dB power gain. The 21.4 MHz IF is connected through the crystal filter with the output on Pin 1. The IA-1 module has an input impedance of 50 ohms and an output impedance of approximately 1200 ohms. The output of the IA-1 module is connected to the input of IF amplifier module IA-2.

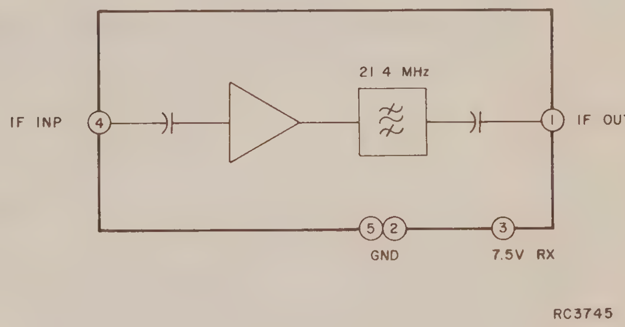


Figure 19 - IF Amplifier

IF Amplifier Module (IA-2)

IF Amplifier module IA-2 contains a 45 dB power gain stage and a 4-pole crystal filter. Input and output impedances of this module are approximately 1200 ohms. The input to the IA-2 module is fed from the output of the IA-1 module. Both input and output pins of the IA-2 module are AC coupled, with the output driving the crystal discriminator module (XD).

Crystal Discriminator Module (XD)

The crystal discriminator module contains two additional IF amplifier stages for an added 90 dB gain. The discriminator module also contains a crystal resonator, audio detector circuit and audio amplifier circuit (See Figure 20). The 21.4 MHz IF input is connected to the input of the IF amplifier stages for gain and limiting. The output of the amplifier stages is connected through the crystal resonator to the audio detector circuit.

The recovered audio from the detector circuit is amplified, buffered and drives the DISC output lead. This lead feeds the audio to the squelch, audio, and optional tone modules. A typical audio level of 200 millivolts rms is achieved with a 3 kHz deviation at an audio frequency of 1 kHz. The frequency response is flat within ±1 dB over the useful audio range of 70-3000 Hz.

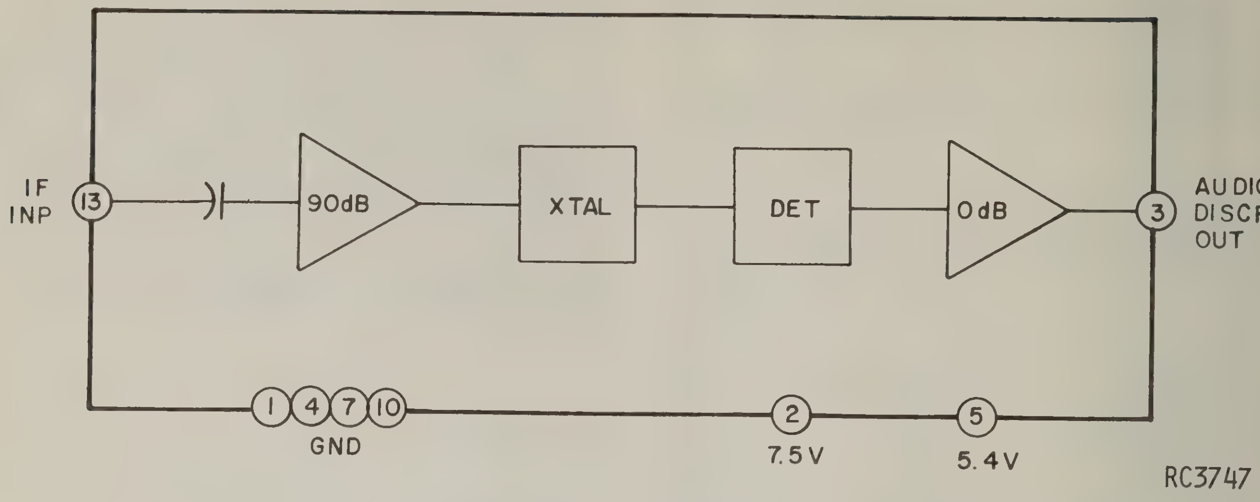


Figure 20 - Crystal Discriminator

Audio Amplifier Module (RX-AA)

The audio amplifier module contains an active low-pass filter, an active notch filter, an attenuator circuit and an audio power amplifier circuit (See Figure 21). Audio from the DISCR lead is connected through the low-pass filter to de-emphasize the audio high frequencies and provide the desired audio response. The output of the low-pass filter is connected to the input of the notch filter. The notch filter eliminates the presence of any Channel Guard tone in the recovered audio. The output of the notch filter is connected to the input of the attenuator circuit.

The attenuator circuit is DC voltage controlled and provides a greater than 70 dB range for the volume control. The module provides filtering for the DC control voltage, reducing any noise from a dirty control. The output of the attenuator circuit is connected to the input of the audio power amplifier circuit.

The audio power amplifier circuit provides 500 milliwatts audio output, with 5% maximum distortion, into a capacitor coupled eight ohm speaker.

The output of the audio power amplifier has thermal overload protection making it indestructable into open or shorted loads.

The audio power amplifier is controlled by the $\overline{\text{RUS}}$ control lead. When the lead is high the amplifier is in the standby mode. The $\overline{\text{RUS}}$ lead shuts down the current to the attenuator circuit and the audio power amplifier circuit. The $\overline{\text{RX-AA MUTE}}$ lead shuts down the current to the power audio amplifier muting the audio output and is used with a priority Search Lock Monitor option (PSLM). The $\overline{\text{AUD INPT MUTE}}$ signal lead is also used with the PSLM option and mutes audio from the discriminator approximately 65 dB preventing popping during priority channel search.

Squelch Module (SQ)

The squelch module contains an attenuator circuit, limiter circuit, high-pass filter, level detector and rectifier circuit, fast/slow squelch circuit, $\overline{\text{CAS}}$ switch and logic circuit (See Figure 22).

Audio and noise is applied to the input of the attenuator circuit. The attenuator circuit is DC controlled by squelch control R702 connected to the $\overline{\text{SQ}}$ lead. The control voltage is from 2.5 to 4.5 VDC with the $\overline{\text{SQ}}$ lead indicating a low voltage for a squelch condition. The output of the attenuator circuit is connected to the input of the limiting circuit. The output of the limiting circuit is connected through the high-pass filter to filter out any audio signal present, preventing squelch clipping.

The filter is peaked at approximately 8 kHz. The noise from the output of the filter is connected to the input of the detector.

The detector senses the noise level present and controls the $\overline{\text{FAST SQUELCH}}$ and $\overline{\text{CAS}}$ outputs. When squelched the FAST SQUELCH control lead is low and the $\overline{\text{CAS}}$ control lead is high. The detector also has hysteresis that prevents instant squelching of the receive circuit when there is a sudden loss of signal. The squelch tail is 50-500 milliseconds depending on how close the squelch control is set to critical. When the signal strength is 20 dBNQ the fast/slow squelch comparator circuit defeats the hysteresis making the squelch tail approximately 8 milliseconds.

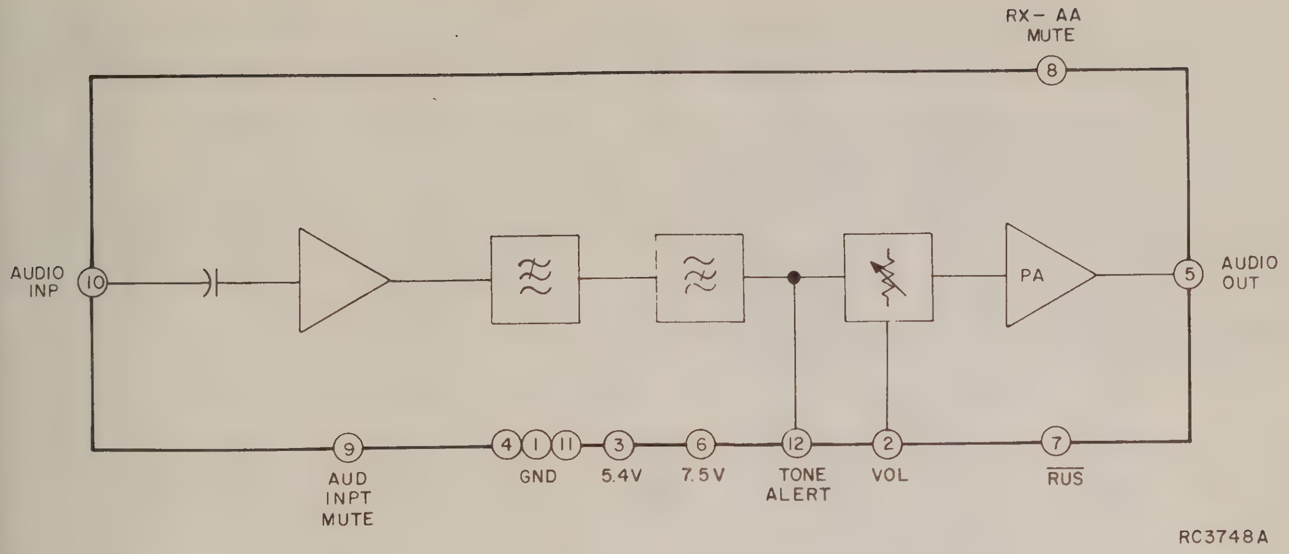

RX- AA MUTE
8
AUDIO INP
10
PA
5
AUDIO OUT
9
AUD INPT MUTE
4 1 11
GND
3
5.4V
6
7.5V
12
TONE ALERT
2
VOL
7
RUS
RC3748A

Figure 21 - Audio Amplifier

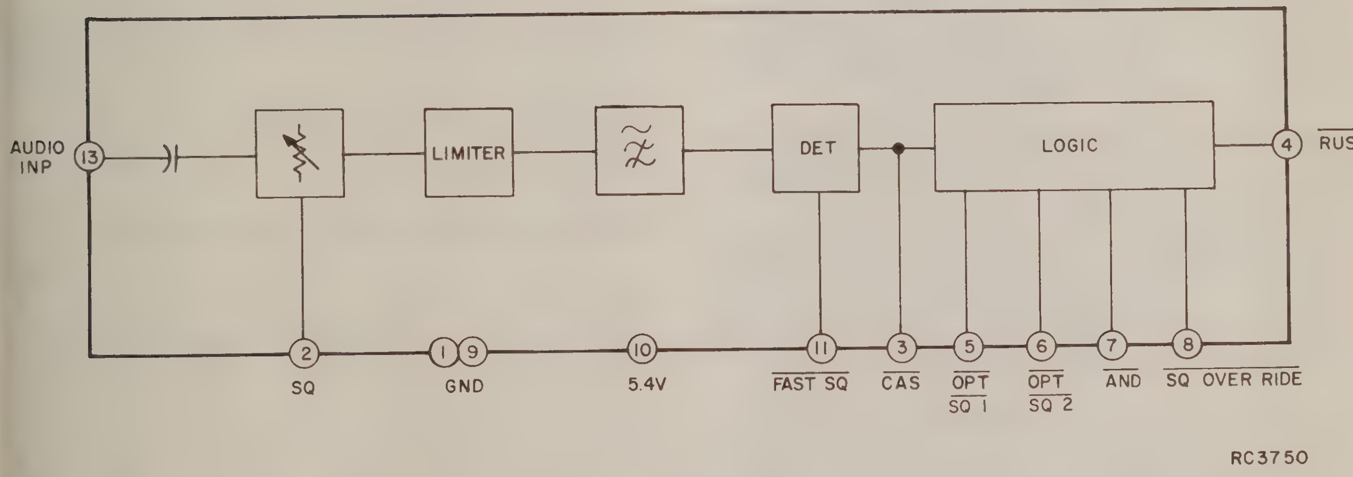

AUDIO INP
13
LIMITER
DET
LOGIC
4
RUS
2
SQ
1 9
GND
10
5.4V
11
FAST SQ
3
CAS
5
OPT SQ 1
6
OPT SQ 2
7
AND
8
SQ OVER RIDE
RC3750

Figure 22 - Squelch

The output of the squelch circuit is connected to the input of the logic circuit and to the carrier activity sensor (CAS) output. When the input to the CAS output is low, the LED channel busy indicator lights.

The logic circuit preforms all system control of the RUS lead, using inputs from two external tone option modules, SQUELCH OVERRIDE and noise squelch from the squelch switch.

The external tone decoder inputs, OPT SQ1 and OPT SQ2, are normally high and are pulled low by external tone decoders which have not decoded. The radio automatically converts to the normal noise squelch when an external decoder is removed from the circuit. Grounding the SQUELCH OVERRIDE forces the squelch to open regardless of any decoder or noise squelch condition.

It two external tone decoders are used, the AND as well as the OR functions of these decoders may be controlled by the AND control lead. In any case, the noise squelch must be open before RUS will be pulled low.

Optional Channel Guard Module (CG)

The Channel Guard module contains a tone frequency synthesizer, encoder, decoder and Squelch Tail Eliminator circuitry (See Figure 23). The synthesizer is programmable to produce Channel Guard tones from 67 to 210.7 Hz in 0.25 Hz increments.

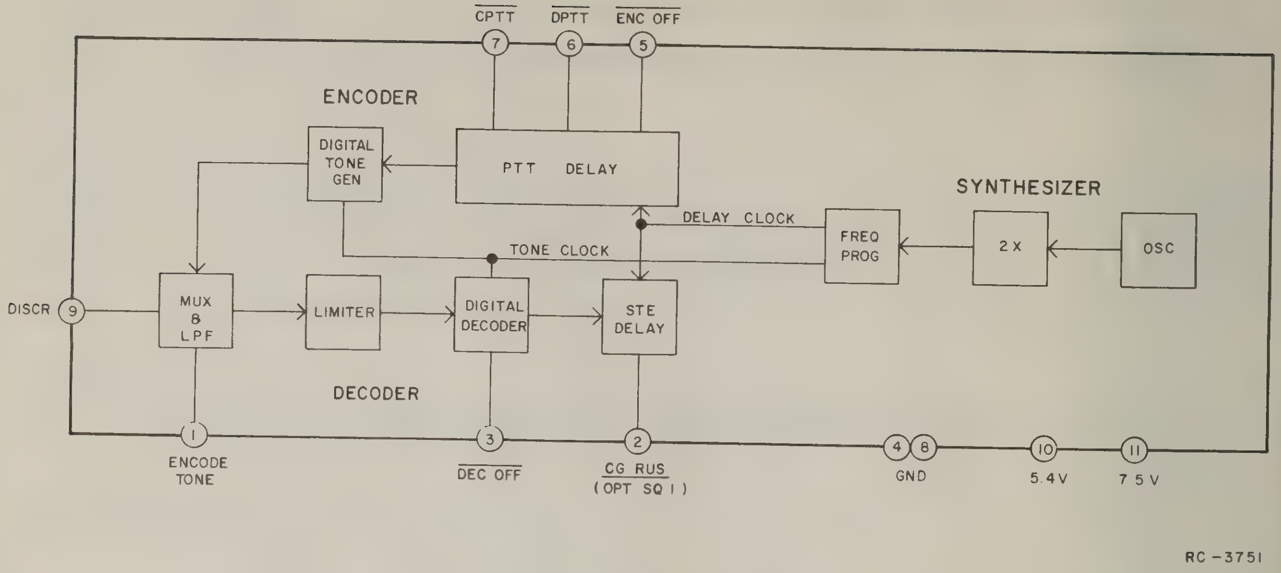


Figure 23 - Channel Guard

The synthesizer uses a crystal controlled 32,768 Hz reference to produce the desired clock inputs to the encoder and decoder circuits and produce digitally generated time delays for the STE circuitry.

When the transmit circuit is keyed, the $\overline{\text{CPTT}}$ lead is pulled low and the Channel Guard module responds by pulling the $\overline{\text{DPTT}}$ lead low, holding the transmit circuit in a keyed condition. The encoder circuit generates a sine wave encode tone which passes through a low pass filter to remove any clock and tone harmonics. This output tone is connected by the CG ENC lead to the transmit audio processor module (TX-AA).

When the radio is unkeyed, the $\overline{\text{CPTT}}$ lead goes high but the PTT delay circuit holds the transmit circuit in a keyed condition for an additional 160 milliseconds by holding the $\overline{\text{DPTT}}$ lead low during this time. During this 160 millisecond time, the encode circuit sends the tone with a 135° phase shift. This combination of 135° phase shift and 160 millisecond delay causes the CG decoder in other receivers to squelch the receiver audio prior to loss of RF signal. This reduces or eliminates the receiver noise burst.

During receive, the receive circuit audio on the DISCR lead is fed to the CG module where it passes through a 212 Hz low pass filter to remove voice information. This prevents voice falsing or clipping in the decoder circuit. The digital decoder compares the frequency of the incoming tone to a reference clock produced by the synthesizer. If the correct tone is detected, the module responds by releasing the CG RUS lead which is normally held in a low voltage condition when the correct tone is not detected.

After decoding the tone, the decoder then looks for a phase shift to occur. If the phase shift occurs, the decoder responds by pulling CG RUS low for 200 milliseconds using the STE delay circuit. This forces the receive circuit to squelch for 200 ms during which time the received carrier should disappear.

Optional Priority Search Lock Monitor (SP)

The priority search lock monitor allows the receive circuit to monitor each receive channel every 40 milliseconds. This is accomplished by alternately switching on each receive oscillator module (See Figure 24).

If the squelch circuit detects a carrier, the $\overline{\text{CAS}}$ control lead on Pin 13 of the SP module will go low. The $\overline{\text{CAS}}$ control lead going low causes the SP module to stop the search, locking on the active receive channel. If the active channel is the non-priority channel, the SP module will continue to search the priority channel for 8 milliseconds every 240 milliseconds. During the priority search, the $\overline{\text{RX-AA MUTE}}$ control lead and the AUD INP MUTE signal lead are pulled low to mute the receiver.

The $\overline{\text{SW OVERRIDE}}$ control lead is also pulled low to prevent the fast squelch from closing during the search. This reduces noise during search to an almost inaudible tick.

If the active channel is a priority channel, the SP module will immediately lock on the priority channel.

Resumption of search on either channel is delayed 640 milliseconds. This delay can be defeated by connecting a jumper between H6 and H7 on flexible printed wire board

A701. This jumper connects 4.5 V to Pin 1 of the SP module.

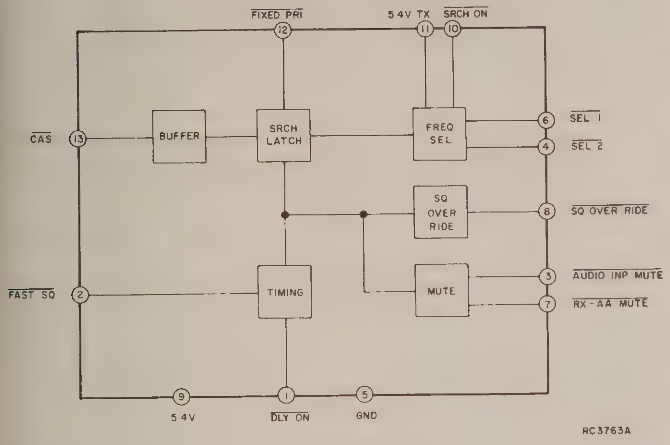

FIXED PRI
5.4V TX
SRCH ON
12
11
10
CAS
13
BUFFER
SRCH LATCH
FREQ SEL
6
SEL 1
4
SEL 2
SQ OVER RIDE
8
SQ OVER RIDE
FAST SQ
2
TIMING
MUTE
3
AUDIO INP MUTE
7
RX-AA MUTE
9
1
5
5.4V
DLY ON
GND
RC3763A

Figure 24 - Priority Search Lock Monitor

The priority channel, normally channel one, can be changed to channel two by connecting a jumper between H8 and H9 on A701. This jumper connects 5.4 V to Pin 12 of the SP module.

The transmit channel is predetermined by internal connections to make the search stop on the priority channel, normally channel one, as soon as the PTT bar is pressed and 5.4 V is applied. To transmit on the non-priority channel the search must be disabled.

With search, on and no channels are active, the search LED indicator will blink at a fast rate. If the priority channel is active the indicator will remain on. If the active channel is non-priority the indicator will remain off.

CONTROLLER CIRCUIT

The MPR Controller Circuit consists of four transmit oscillator modules (TX-X0), four receive oscillator modules (RX-X0) and a simple or deluxe controller module (CL1/CL2). Twelve position BCD channel select rotary switch, S1, connects through flexible printed wire board A703 to controller board A3501. The BCD input leads of A703 connect through the controller module to control ten oscillator module keying leads.

Simple Controller Module (CL1)

The simple controller module contains a CMOS BCD to decimal decoder (See Figure 25). The BCD inputs to CL1 can select any one of 10 keying leads depending on which position the channel select switch is in. When a keying lead is selected its output goes low (See Figure 26).

Controller module CL1 is not programmable and there are no provisions for repeat oscillators or system control.

Deluxe Controller Module (CL2)

The Deluxe Controller Module contains a CMOS BCD to decimal decoder, a PROM controller and an 8X32 address PROM (See Figure 27).

For any setting of channel select switch S1, CL2 can control any one of ten receive oscillators and the operation of four receive system functions or options. Also, for the same channel select position, the controller can control any one of ten transmit oscillators and the operation of four transmit system functions or options.

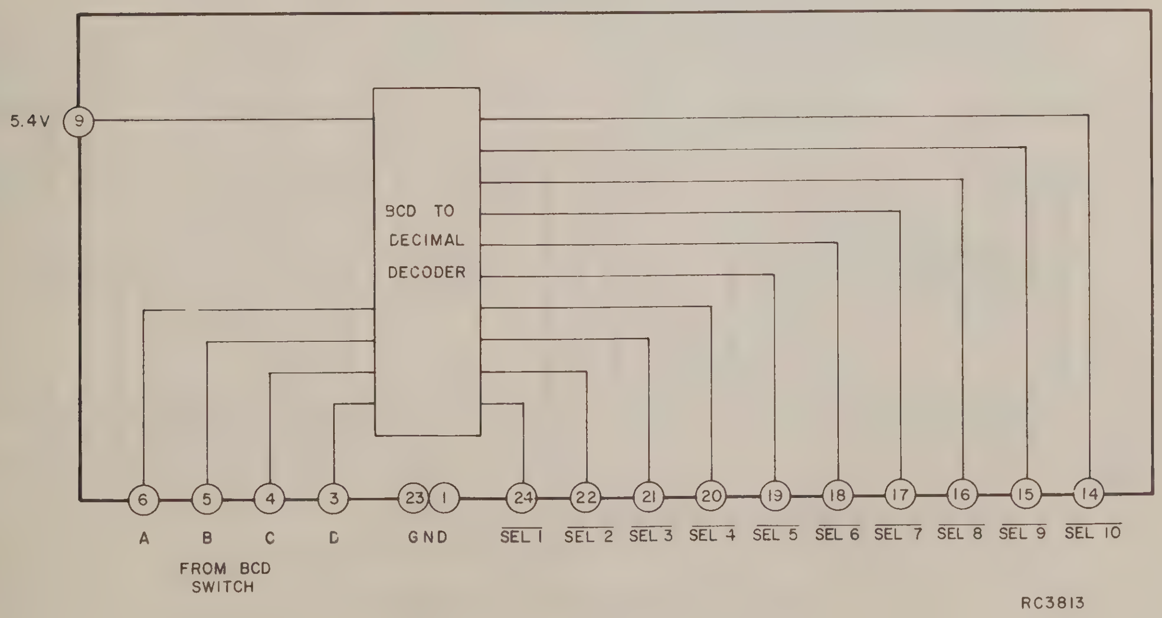

5.4V
9
BCD TO DECIMAL DECODER
6
5
4
3
23
1
24
22
21
20
19
18
17
16
15
14
A
B
C
D
GND
SEL 1
SEL 2
SEL 3
SEL 4
SEL 5
SEL 6
SEL 7
SEL 8
SEL 9
SEL 10
FROM BCD SWITCH
RC3813

Figure 25 - Simple Controller

	BCD INPUT PIN NUMBERS				OUTPUT PIN NUMBERS									
	3	4	5	6	24	22	21	20	19	18	17	16	15	14
CHANNEL NUMBER	BCD INPUTS				CHANNEL SELECT OUTPUTS									
1	0	0	0	0	0	1	1	1	1	1	1	1	1	1
2	0	0	0	1	1	0	1	1	1	1	1	1	1	1
3	0	0	1	0	1	1	0	1	1	1	1	1	1	1
4	0	0	1	1	1	1	1	0	1	1	1	1	1	1
5	0	1	0	0	1	1	1	1	0	1	1	1	1	1
6	0	1	0	1	1	1	1	1	1	0	1	1	1	1
7	0	1	1	0	1	1	1	1	1	1	0	1	1	1
8	0	1	1	1	1	1	1	1	1	1	1	0	1	1
9	1	0	0	0	1	1	1	1	1	1	1	1	0	1
10	1	0	0	1	1	1	1	1	1	1	1	1	1	0

"0" IS ≤ 0.5 VDC
"1" IS ≥ 5 VDC

RC3861

Figure 26 - Simple Controller Logic Table

The inputs to CL2 are four BCD input leads from channel select switch S1 and the DPTT control lead connected to the T/R input. This T/R input determines transmit or receive PROM selections.

The PROM controller powers up the PROM and stores the current address and PROM outputs whenever it senses an address change. For each address, the PROM supplies eight outputs. Four of these outputs are further decoded by the BCD to decimal decoder to provide ten keying leads. Whenever a transmit or receive channel is selected by switch S1 the keying lead of CL2 corresponding to the selected channel is a logical "0". All other outputs are logical "1's". Refer to Figure 28 for a Deluxe Controller logic table. The remaining four PROM outputs are for system control. These four outputs are pre-programmed to customer specification.

	T/R AND BCD INPUT PIN NUMBERS					OPTION OUTPUT PIN NUMBERS				OUTPUT PIN NUMBERS									
	2	3	4	5	6	13	12	11	10	24	22	21	20	19	18	17	16	15	14
CHANNEL NUMBER	T/R INPUT	BCD ADDRESS INPUTS				OPTION SELECT OUTPUTS				CHANNEL SELECT OUTPUTS									
TX 1	0	0	0	0	0	TX OPTIONS PRE-PROGRAMMED TO CUSTOMER SPECIFICATIONS				0	1	1	1	1	1	1	1	1	1
TX 2	0	0	0	0	1					1	0	1	1	1	1	1	1	1	1
TX 3	0	0	0	1	0					1	1	0	1	1	1	1	1	1	1
TX 4	0	0	0	1	1					1	1	1	0	1	1	1	1	1	1
TX 5	0	0	1	0	0					1	1	1	1	0	1	1	1	1	1
TX 6	0	0	1	0	1					1	1	1	1	1	0	1	1	1	1
TX 7	0	0	1	1	0					1	1	1	1	1	1	0	1	1	1
TX 8	0	0	1	1	1					1	1	1	1	1	1	1	0	1	1
TX 9	0	1	0	0	0					1	1	1	1	1	1	1	1	0	1
TX 10	0	1	0	0	1					1	1	1	1	1	1	1	1	1	0
RX 1	1	0	0	0	0	RX OPTIONS PRE-PROGRAMMED TO CUSTOMER SPECIFICATIONS				0	1	1	1	1	1	1	1	1	1
RX 2	1	0	0	0	1					1	0	1	1	1	1	1	1	1	1
RX 3	1	0	0	1	0					1	1	0	1	1	1	1	1	1	1
RX 4	1	0	0	1	1					1	1	1	0	1	1	1	1	1	1
RX 5	1	0	1	0	0					1	1	1	1	0	1	1	1	1	1
RX 6	1	0	1	0	1					1	1	1	1	1	0	1	1	1	1
RX 7	1	0	1	1	0					1	1	1	1	1	1	0	1	1	1
RX 8	1	0	1	1	1					1	1	1	1	1	1	1	0	1	1
RX 9	1	1	0	0	0					1	1	1	1	1	1	1	1	0	1
RX 10	1	1	0	0	1					1	1	1	1	1	1	1	1	1	0

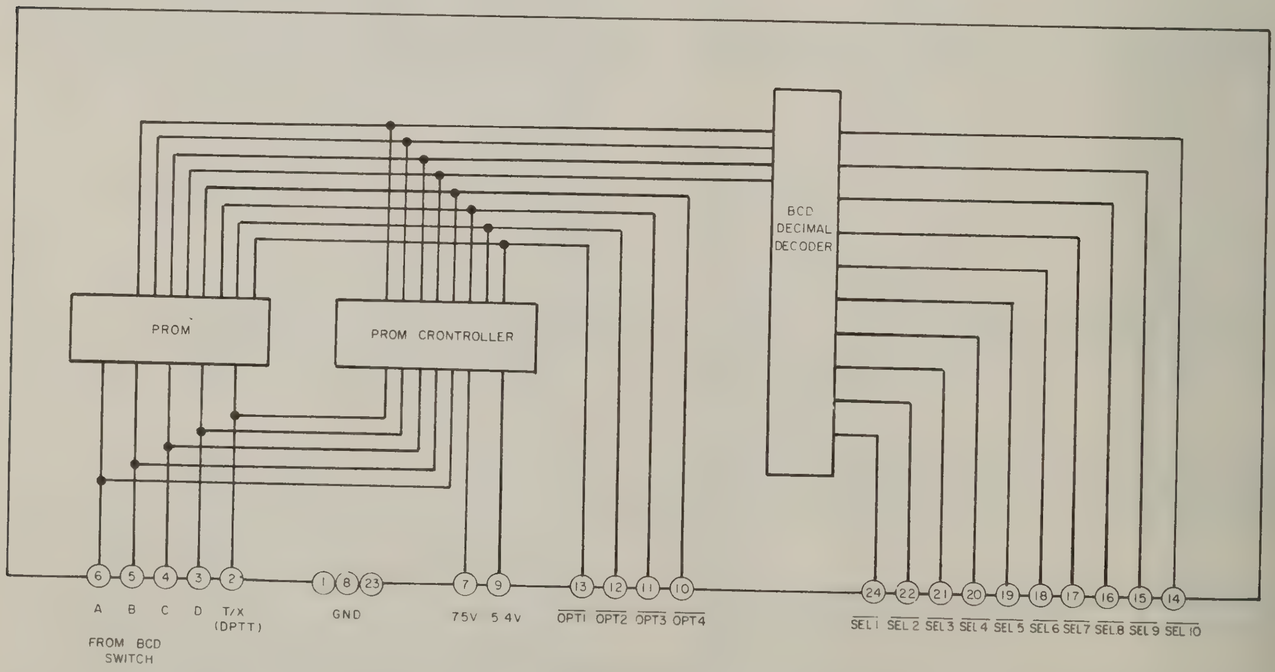
"0" IS ≤ 0.5 VDC
"1" IS ≥ 5.0 VDC

RC3862

Figure 28 - Deluxe Controller Logic Table

Compatibility

Both Controller Modules, CL1 and CL2, are pin compatible. If it is desirable to



RC3860

Figure 27 - Deluxe Controller Module

upgrade a system by adding repeated oscillators or function control, all that is necessary is to order the appropriately programmed controller. CL2 controller PROMs are custom programmed to the customer order and will be programmed for one TX and one RX oscillator selection above the actual number ordered. This allows channel expansion above what is ordered with the restriction that oscillators may not be repeated or system functions controlled. A new controller is necessary if these functions are needed.

EXTENDER CIRCUIT

The extender circuit increases the RF channel capability of the MPR P2C combination to ten RF Channels. It consists of flexible printed wire board A3502 and oscillator board A3601. The flexible printed wire board connects the oscillator board to the controller circuit. Four transmit oscillator modules and four receive oscillator modules may be mounted on the oscillator board.

POWER DISTRIBUTION

Power for the MPR is supplied by a 7.5 Volt battery pack connected to connector J702 (See Figure 29). The negative terminal of the battery pack connects through the shell of connector J702 and a flexible metal strap to the system board ground pattern. The positive terminal of the battery pack connects through the system ON/OFF switch and flexible printed wire board to the system board for distribution. All distribution leads are on the back side of the multi-layered system board.

Some modules on the system board operate directly from the battery voltage or through a R-C de-coupled 7.5 volt lead for noise reduction. During transmit, an additional regulated 4.8 Volts is generated by the PL module to run the VO module. A continuous and keyed 5.4 volts is also provided by voltage regulator module (VR).

The 7.5 Volts from the battery connects through relay K901 and resistor R903 to the receive RF amplifier module (RA), frequency multiplier module (FX), IF amplifier modules (IA-1 and IA-2) and discriminator module (XD).

Voltage Regulator Module (VR)

The voltage regulator module, powered from the 7.5 volts supply, current limited and highly stable, generates a continuous 5.4 volt output (See Figure 30). During transmit, when the $\overline{\text{DPTT}}$ lead is low, the regulator module also provides a keyed 5.4 volt output for transmit functions. When the transmit circuit is keyed the regulator module activates the system relay by saturating a keying transistor.

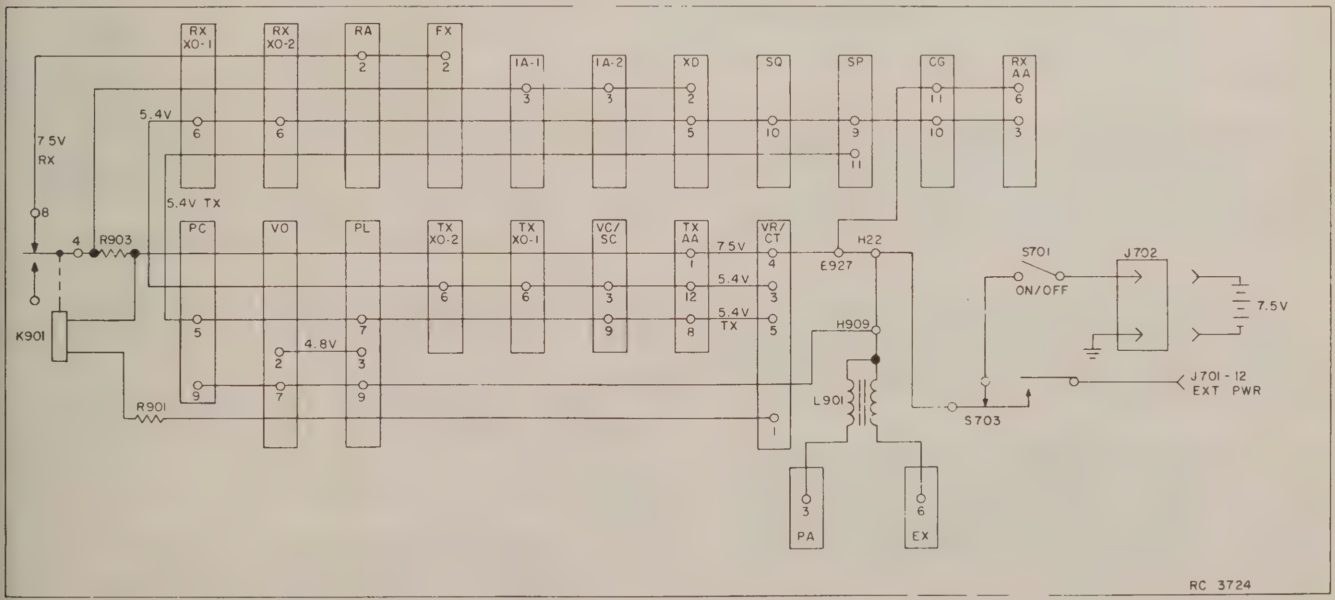


Figure 29 - Power Distribution

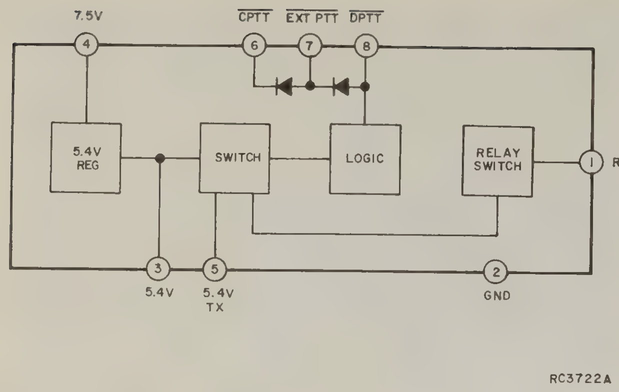


Figure 30 - Voltage Regulator

External Power

An external power source can be connected at J701-12. When Pin 12 of J701 is pressed, battery voltage is removed from the radio. The radio may now be powered by an external 7.5V source, completely bypassing ON/OFF switch S701. In vehicular chargers, the radio is turned on and off from the charger. The DC return should be the ground contact on the battery pack.

WARNING

When powering the radio from an external supply for service purposes, use a suitably fused 5 Amp supply or a 3 amp current limited supply. DO NOT USE a PE battery pack because a system short can cause unrepairable damage to the multi-layered system board or to the flexible printed wire board.

BATTERY PACK

Two battery packs, one with 750 mAh capacity and one with 1200 mAh capacity are available for use with the MPR radio. Both battery packs contain six nickel-cadmium battery cells to provide a nominal 7.5 volts DC output.

To protect the battery pack from external short circuits, the positive (+) charging contact is diode protected and the positive output terminal is fused. The fuse is replaceable.

An internal thermistor senses variations in battery pack temperature to automatically control a charger and provide a maximum charge without overheating the battery pack. Both battery packs can be recharged in one hour.

The battery pack is fully charged and shipped to the customer ready for use. If the battery pack is stored for any length of time it should be fully re-charged before placing into service.

Charger combinations for re-charging the MPR battery packs are available with charge times of 1-hour, 3-hours and 14-hours. A combination can be a single unit desk or a vehicular charger. It can also be a wall or bench mounted rack charger with a multiple of charge units.

Charge Level

The charge level of the battery packs can be measured by connecting a voltmeter across the charge contacts and measuring the voltage with the transmitter keyed.

For the rechargeable battery packs, a fully charged battery pack should provide a reading of 7.5 and 8 Volts. A fully discharged battery pack should provide a reading of no less than 6 Volts.

Battery Check

One of the best service checks for the MPR rechargeable battery packs can be easily obtained by measuring the milliampere-hour capacity. The results of the measurement can then be compared with the rated capacity of the battery pack to determine the general condition of the rechargeable batteries.

First, it is necessary to find the percentage of rated capacity. This is obtained by measuring the time it takes to discharge a fully charged battery pack until the voltage drops to 6.0 Volts. The proper load resistor for each of the battery packs is shown in Table 1.

Then use the formula $\frac{T}{60} = \%$ where "T" is the time in minutes required to discharge the battery pack to 6 Volts and % is the percentage of rated capacity the battery delivered to a load. For example: assume the standard battery pack voltage dropped to 6 Volts in 50 minutes:

$\frac{50}{60} = .83$ (percentage of capacity)

Now multiply the percentage of capacity by its rated capacity (see Table 1):

.83 x 750 mA = 622.5 mAh

The 622.5 milliampere-hours is the actual capacity of the battery pack.

NOTE

As the voltage drops very fast near the end of the discharge cycle, be very careful to avoid discharging the battery pack below 6.0 Volts.

Table 1 - Capacity Measurement Data

RECHARGEABLE BATTERY PACK	RATED CAPACITY	AVERAGE DISCHARGE RATE (for 60 minutes)	LOAD RESISTOR (R_L)	END VOLTAGE
19D429763G1 (6 cells)	750 mAh	750 mA	10 ohms 8 Watts	6 VDC
19D429777G1 (6 cells)	1200 mAh	1200 mA	6.25 ohms 12 Watts	6 VDC

CONTROL LEADS

$\overline{\text{AND}}$	- Receiver audio is heard only when the noise squelch and a tone option open simultaneously. When two tone options are present, the tone option can use the AND function and the noise squelch can use an OR function.
$\overline{\text{CAS}}$	- Carrier Activity Sensor goes low when the noise squelch is open. This does not mean the receiver audio can be heard.
$\overline{\text{CPTT}}$	- This is an OR function of $\overline{\text{PTT}}$ and $\overline{\text{EXT PTT}}$.
$\overline{\text{DEC OFF}}$	- A low on this lead turns a Channel Guard decoder off. The DEC OFF lead is grounded by a switch on the Control panel, placed in the MONITOR position.
$\overline{\text{DLY ON}}$	- Delays the resumption of search by the SP until the radio is squelched.
$\overline{\text{DPTT}}$	- Delayed PTT control lead from a tone module used for squelch tail elimination.
$\overline{\text{ENC - OFF}}$	- A low on this lead turns off a Channel Guard encoder off.
$\overline{\text{EXT - PTT}}$	- External PTT lead from VDC connector.
$\overline{\text{FAST SQ}}$	- A low on this lead indicates the priority fast squelch has not detected a carrier.
$\overline{\text{FIXED PRI}}$	- When low, priority channel is fixed. When high, the priority channel is set by the channel select switch.
$\overline{\text{LOW POWER}}$	- A low on this lead, with the low power option, indicates the transmit circuit is in the low power condition.
$\overline{\text{MIC MUTE}}$	- A low on this lead mutes all transmit microphone inputs. This enables data to be transmitted through the tone input signal lead with the microphone muted.
$\overline{\text{OPT SQ1}}$	- This lead is normally high on a noise squelch only unit; meaning, an external tone option has not caused the squelch to close. This lead is pulled low by a tone option when it is installed and has not decoded.
$\overline{\text{OPT SQ2}}$	- This lead is the same as $\overline{\text{OPT SQ1}}$ except for a second tone option.
$\overline{\text{PTT}}$	- Internal Push-to-talk; a low on this lead indicates the unit has been keyed by the side PTT bar.
$\overline{\text{RUS}}$	- Receiver Unsquelch Signal goes low when the receive audio amplifier is on.
$\overline{\text{RX-AA MUTE}}$	- A low on this lead turns off the receiver audio amplifier.
$\overline{\text{SEL-1}}$ through $\overline{\text{SEL-10}}$	- A low on this lead indicates channel one has been keyed.
$\overline{\text{SQUELCH OVERRIDE}}$	- A low on this lead forces the audio to open regardless of the noise squelch or tone decoder condition.
$\overline{\text{SRCH ON}}$	- A low on this lead turns the SP on.
$\overline{\text{UNLOCK}}$	- A low on this lead occurs when phase lock has not been achieved, holding the transmit PA stages in an off condition.
$\overline{\text{VOX OFF}}$	- A low on this lead defeats VOX.

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STEP 4.

To replace the speaker and microphone remove the four Phillips-head screws holding the speaker retaining plates and remove the speaker. The microphone is held in place only by the rubber mike boot and can easily be removed.

STEP 5.

To replace controls and LED indicators, remove the antenna by unscrewing the antenna at Ⓕ and remove it from the antenna stud.

Loosen set screws at Ⓖ and remove knobs. With a flat-blade screw driver snap top cover off at Ⓗ. The slotted nuts holding the controls are easily accessible. When disconnecting Option controls remove the leads from the control and not the flexible printed wire. The Volume control, Squelch control and LED indicators must be unsoldered from the printed wire board.

STEP 6.

To remove modules from the system board, remove both front and back covers. A simple bent paper clip can be used as a tool to push a module from the board. A number 64 drill bit in a pin vise makes a sturdier and more permanent tool. A piece of .036 steel wire can be used in place of the drill bit. Ground pins with knockout bottoms are present on the system board for each module except for the Ex and PA modules. To remove a module, take the paper clip, insert it into the ground pin of the module to be removed Ⓙ and push the module from the board. To remove the Ex or PA module insert the paper clip into a hole provided in the center of the board for removal of the module and push the module from the board.

Some modules have screws holding them in place. Before attempting to push a module from the board, remove any screws present Ⓚ.

CONTROL LEADS

$\overline{\text{AND}}$ - Receiver audio is heard only when the noise squelch and a tone option open simultaneously. When two tone options are present, the tone option can use the AND function and the noise squelch can use an OR function.

$\overline{\text{CAS}}$ - Carrier Activity Sensor goes low when the noise squelch is open. This does not mean the receiver audio can be heard.

$\overline{\text{CPTT}}$ - This is an OR function of $\overline{\text{PTT}}$ and $\overline{\text{EXT PTT}}$.

$\overline{\text{DEC OFF}}$ - A low on this lead turns a Channel Guard decoder off. The DEC OFF lead is grounded by a switch on the Control panel, placed in the MONITOR position.

$\overline{\text{DLY ON}}$ - Delays the resumption of search by the SP until the radio is squelched.

$\overline{\text{DPTT}}$ - Delayed PTT control lead from a tone module used for squelch tail elimination.

$\overline{\text{ENC - OFF}}$ - A low on this lead turns off a Channel Guard encoder off.

$\overline{\text{EXT - PTT}}$ - External PTT lead from VDC connector.

$\overline{\text{FAST SQ}}$ - A low on this lead indicates the priority fast squelch has not detected a carrier.

$\overline{\text{FIXED PRI}}$ - When low, priority channel is fixed. When high, the priority channel is set by the channel select switch.

$\overline{\text{LOW POWER}}$ - A low on this lead, with the low power option, indicates the transmit circuit is in the low power condition.

$\overline{\text{MIC MUTE}}$ - A low on this lead mutes all transmit microphone inputs. This enables data to be transmitted through the tone input signal lead with the microphone muted.

$\overline{\text{OPT SQI}}$ - This lead is normally high on a noise squelch only unit; meaning, an external tone option has not caused the squelch to close. This lead is pulled low by a tone option when it is installed and has not decoded.

$\overline{\text{OPT SQ2}}$ - This lead is the same as $\overline{\text{OPT SQI}}$ except for a second tone option.

$\overline{\text{PTT}}$ - Internal Push-to-talk; a low on this lead indicates the unit has been keyed by the side PTT bar.

$\overline{\text{RUS}}$ - Receiver Unsquelch Signal goes low when the receive audio amplifier is on.

$\overline{\text{RX-AA MUTE}}$ - A low on this lead turns off the receiver audio amplifier.

$\overline{\text{SEL-1}}$ through $\overline{\text{SEL-10}}$ - A low on this lead indicates channel one has been keyed.

$\overline{\text{SQUELCH OVERRIDE}}$ - A low on this lead forces the audio to open regardless of the noise squelch or tone decoder condition.

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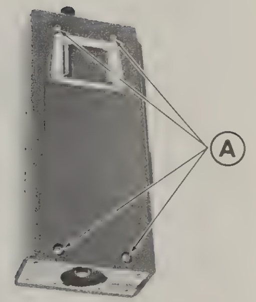
DISASSEMBLY PROCEDURE

Caution: Always remove the battery pack before removing any component board to avoid blowing the fuse.

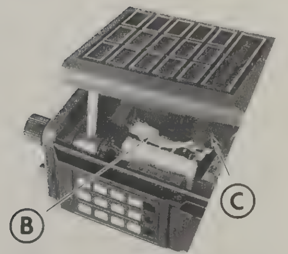
Equipment Required

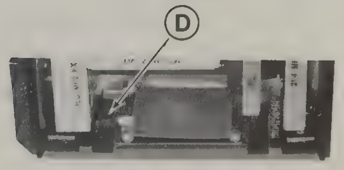
- Small Phillips-head screwdriver.
- Small flat-blade screwdriver.
- Needlenose pliers.
- Allen-head wrench for removing set screws.
- Pencil-type soldering iron (40-60 watts) with a fine tip.



STEP 1.

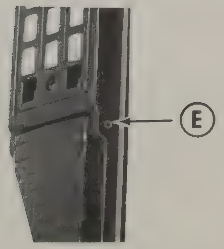
To gain access to the radio, loosen, but do not remove, the four captive screws at Ⓐ. Carefully remove the back cover. For normal radio alignment, the back cover is all that need be removed. When tightening the captive screws, they should be no tighter than 4 ±.5 inch-pounds.





STEP 2.

To gain access to the module side of the radio, step 1 must be completed and the radio turned over. Carefully remove the front cover and disconnect the speaker at Ⓑ.
When replacing the front cover the speaker leads must be routed as shown. The rubber microphone cover should be pushed in at Ⓒ to allow the cover to snap shut. Also the flexible printed wire board may require lifting at Ⓓ to allow the standoff to fit into the slot in the housing.

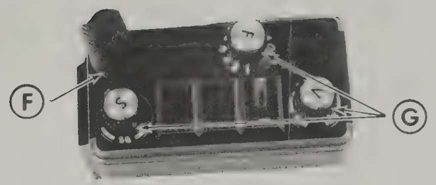


STEP 3.

To remove the PTT switch, push out pin at Ⓔ. The PTT bar should come right out.

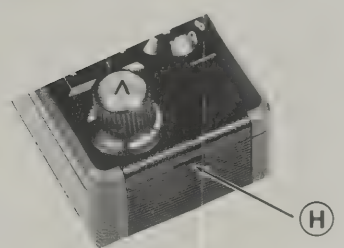
STEP 4.

To replace the speaker and microphone remove the four Phillips-head screws holding the speaker retaining plates and remove the speaker. The microphone is held in place only by the rubber mike boot and can easily be removed.

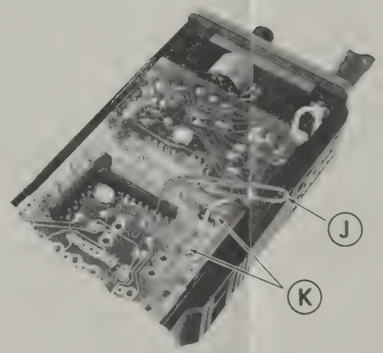


STEP 5.

To replace controls and LED indicators, remove the antenna by unscrewing the antenna at Ⓕ and remove it from the antenna stud.



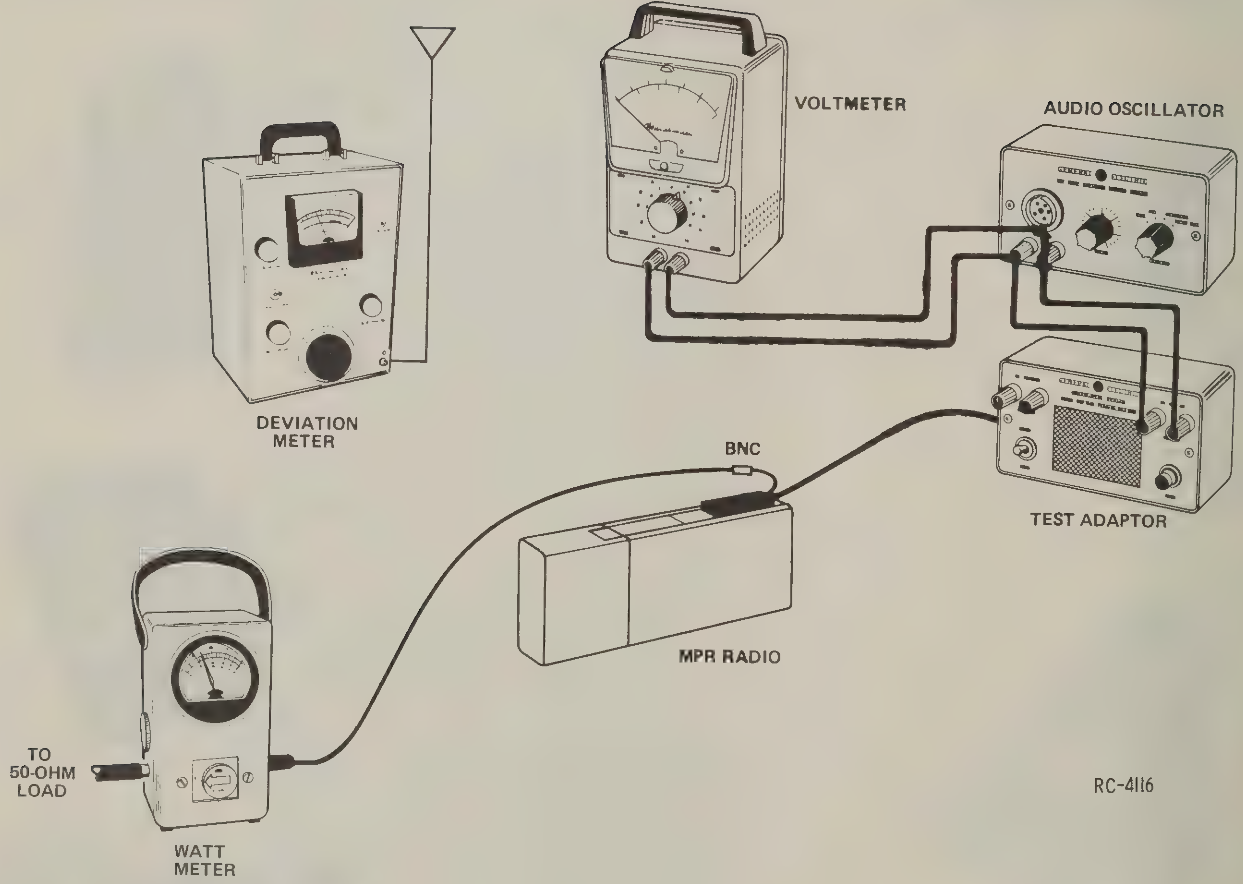
Loosen set screws at Ⓖ and remove knobs. With a flat-blade screw driver snap top cover off at Ⓗ. The slotted nuts holding the controls are easily accessible. When disconnecting Option controls remove the leads from the control and not the flexible printed wire. The Volume control, Squelch control and LED indicators must be unsoldered from the printed wire board.



STEP 6.

To remove modules from the system board, remove both front and back covers. A simple bent paper clip can be used as a tool to push a module from the board. A number 64 drill bit in a pin vise makes a sturdier and more permanent tool. A piece of .036 steel wire can be used in place of the drill bit. Ground pins with knockout bottoms are present on the system board for each module except for the Ex and PA modules. To remove a module, take the paper clip, insert it into the ground pin of the module to be removed Ⓙ and push the module from the board. To remove the Ex or PA module insert the paper clip into a hole provided in the center of the board for removal of the module and push the module from the board.

Some modules have screws holding them in place. Before attempting to push a module from the board, remove any screws present Ⓚ.


VOLTMETER
AUDIO OSCILLATOR
DEVIATION METER
BNC
TEST ADAPTOR
MPR RADIO
TO 50-OHM LOAD
WATT METER
RC-4116

RECEIVE CIRCUIT ALIGNMENT

Electric Test Adaptor 4EX12A11.

4 MHz signal source.

Hz signal source (Used in setting frequency).

meter (20,000 ohms/volt DC).

eter.

on Analyzer.

y remove back cover from radio (see Disassembly e).

test equipment as shown (see Receive Circuit cedures).

ut of 138-174 MHz signal source for approximately volts.

ELCH control fully clockwise.

RF tuning screws out of the casting.

ble frequency, place the channel select switch in st frequency position.

equipment on.

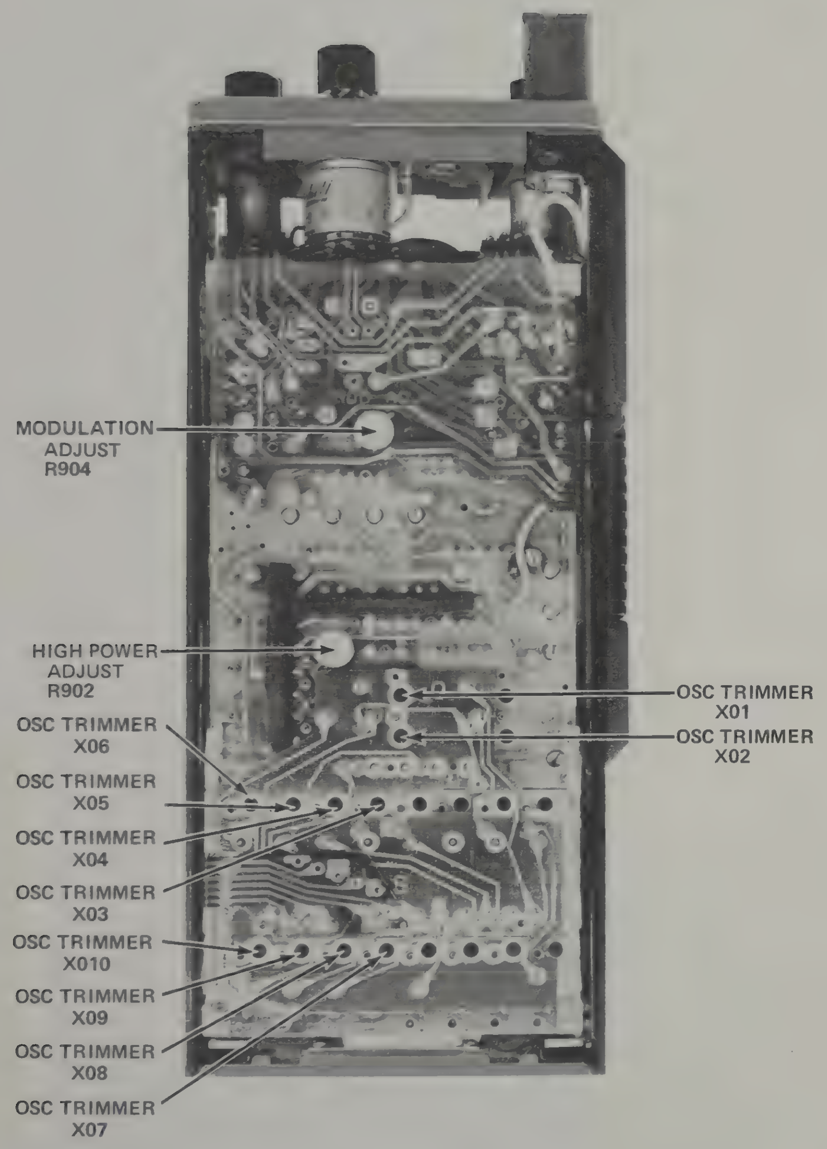
RE

RECEIVE
(RC
L2 (F
L1 (F
L3 (R
L4 (R
OS
OS

	PROCEDURE
	FREQUENCY MULTIPLIER (FX)
	With volt/ohmmeter between TEST PT and ground, tune L3 for a peak indication (approximately 0.6 VDC).
R L3	With RF voltmeter between Pin 5 of the FX module and ground, tune MULTIPLIER HELICALS L1, L2 and L3 for maximum injection signal.
	RECEIVE CONVERTER (RC)
LS 5	With an on-frequency signal tune RF HELICALS L1, L2, L3 and L4 for maximum quieting. Reduce the signal level as the quieting increases keeping the receive circuit out of limiting.
	FREQUENCY ADJUSTMENT
	While applying an on-frequency signal, loosely couple a 21.4 MHz signal to the converter. Adjust the oscillator trimmer(s) for a zero beat frequency between the two signals.

ALIGNMENT PROCEDURE

138—174 MHz RECEIVE CIRCUIT TYPES ER109B/C AND ER110B/C



ALIGNMENT & TEST PROCEDURES

138—174 MHz TRANSMIT CIRCUIT TYPES KT167B/C AND KT168B/C

TRANSMIT CIRCUIT ALIGNMENT

EQUIPMENT

1. General Electric Test Adapter 4EX12A11.
2. General Electric Audio Generator 4EX6A10.
3. General Electric Battery Pack Eliminator 19C328969G1.
4. Regulated Power Supply, set at 7.5 VDC and capable of 3 amperes, connected to the Battery Pack Eliminator.
5. Ammeter, capable of 3 amperes, in series with the power supply and Battery Eliminator.
6. Deviation meter.
7. 50 ohm terminating watt meter.
8. Frequency Counter.

PRELIMINARY

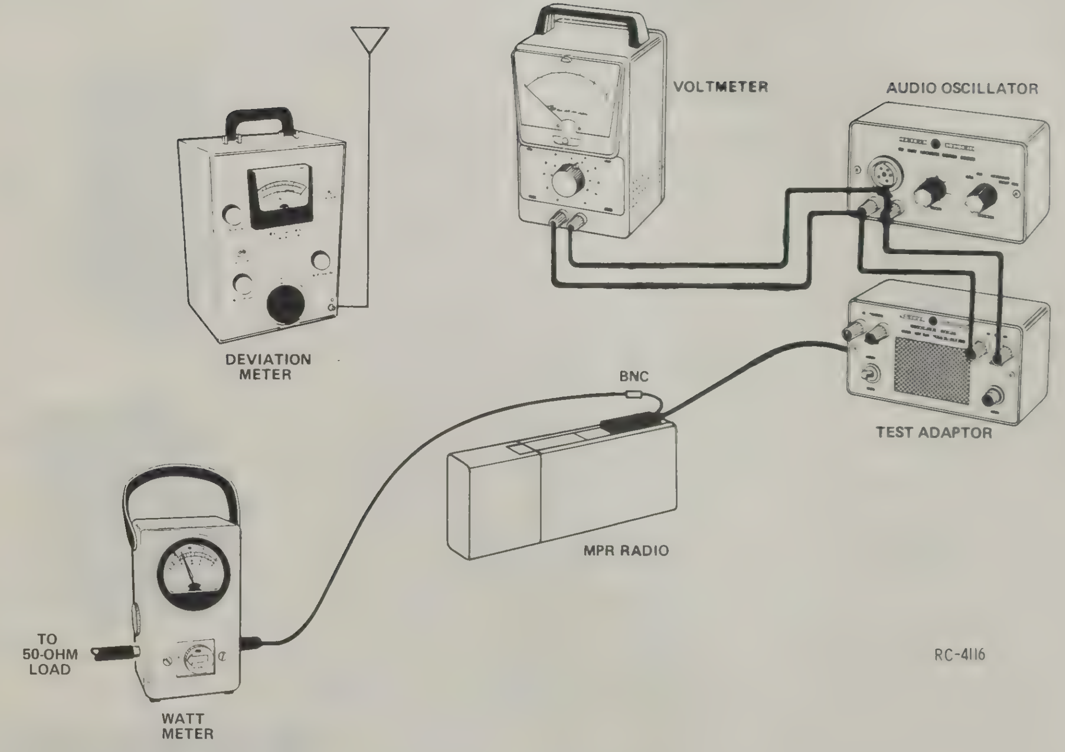
1. Carefully remove the back cover from radio (See Disassembly Procedure).
2. Connect equipment as shown.
3. Set Audio Oscillator for 120 millivolts RMS at 1 kHz.
4. Set HI PWR adjust R902 fully counterclockwise.
5. If present, set LOW POWER ADJ R2101 fully counterclockwise.

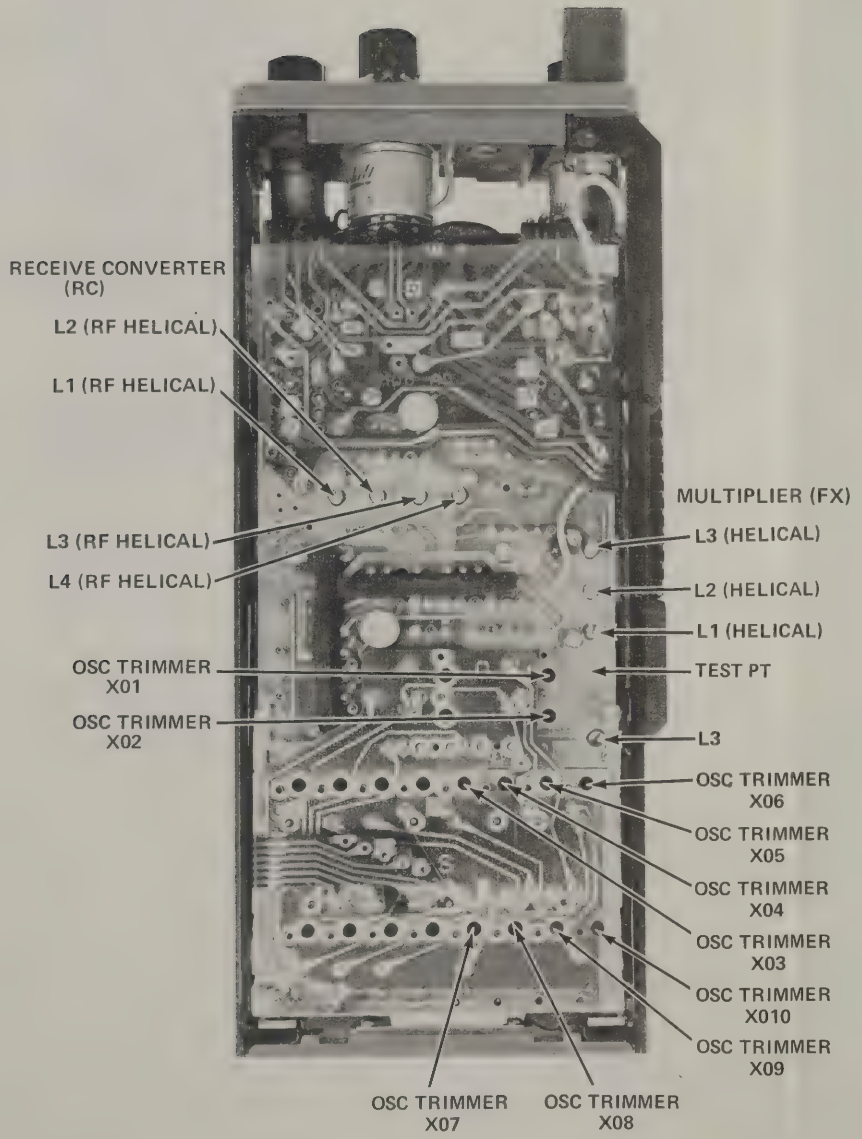
NOTE

In units equipped with the HI/LO power option, the HI/LO power may be slaved to the channel select switch. When making power adjustments insure the channel select switch is in a position where HI power is enabled for HI power out. In the case of LO power adjustments, insure the channel select switch is in a position where LO power is enabled for LO power out.

ALIGNMENT PROCEDURE

STEP	TUNING CONTROL	TYPICAL METER READING	PROCEDURE
HIGH POWER ADJUST			
1	R902	Transmit type KT167B/C - 2.5 Watts at 1.2 amperes or less.	Key transmit circuit and adjust HI PWR ADJUST R902 clockwise for rated current.
2	Multi-frequency switch	Transmit type KT168B/C - 6.0 Watts at 2.4 amperes or less.	Switch multi-frequency switch and determine which channel has the highest current.
3	R902		Re-adjust R902 until the channel with the highest current has rated current.
LOW POWER ADJUST			
4	R2101	Transmit type KT167B/C - 1 to 2.5 Watts.	Key transmit circuit and adjust LOW PWR ADJ R2101 clockwise to rated power output.
5	Multi-frequency switch	Transmit type KT168B/C - 1 to 5 Watts.	Switch multi-frequency switch and determine which channel has the highest current.
6	R2101		Re-adjust R2101 until the channel with the highest current has rated power output.
FREQUENCY ADJUSTMENT			
7	X0-1/X0-10		Key transmit circuit and adjust X0-1/X0-10 oscillator trimmers for proper oscillator frequency.
MODULATION ADJUST			
Voice Only			
8	R904	4.5 kHz deviation	Key the transmit circuit and adjust MOD ADJ R904 until deviation meter indicates 4.5 kHz.
9	Multi-frequency switch		Switch multi-frequency switch and determine which channel has the highest deviation.
10	R904		Re-adjust R904 for 4.5 kHz deviation on the channel with the highest deviation.
Voice and Channel Guard			
11	R904	4.5 kHz deviation	With the multi-frequency switch on a channel guarded channel, key the transmit circuit and adjust R904 until the deviation meter indicates 4.5 kHz.
12	Multi-frequency switch		Switch the multi-frequency switch and determine which channel has the highest deviation.
13	R904		Re-adjust R904 for 4.5 kHz deviation on the channel with the channel with the highest deviation.
14	--	500 Hz to 1 kHz deviation	To check the Channel Guard output, remove the audio oscillator input. The Channel Guard deviation should be between 500 Hz and 1 kHz.
Voice and Compressor			
15	--	35 millivolt RMS at 1 kHz	Set audio oscillator for 35 millivolts RMS at 1 kHz.
16	R904	3.8 kHz deviation	Key transmit circuit and adjust R904 until deviation meter indicates 3.8 kHz.
17	Multi-frequency switch		Switch the multi-frequency switch and determine which channel has the highest deviation.
18	R904		Re-adjust R904 for 3.8 kHz deviation on the channel with the highest deviation.
Voice, Channel Guard and Compressor			
1[illegible]	--	3.5 millivolt RMS at 1 kHz	Set audio oscillator for 35 millivolts RMS at 1 kHz.
20	R904	3.8 kHz deviation	Key transmit circuit and adjust R904 until deviation meter indicates 3.8 kHz.
21	Multi-frequency switch		Switch multi-frequency switch and determine which channel has the highest deviation.
22	R904		Re-adjust R904 for 3.8 kHz deviation on the channel with the highest deviation.




RECEIVE CONVERTER (RC)
L2 (RF HELICAL)
L1 (RF HELICAL)
L3 (RF HELICAL)
L4 (RF HELICAL)
OSC TRIMMER X01
OSC TRIMMER X02
MULTIPLIER (FX)
L3 (HELICAL)
L2 (HELICAL)
L1 (HELICAL)
TEST PT
L3
OSC TRIMMER X06
OSC TRIMMER X05
OSC TRIMMER X04
OSC TRIMMER X03
OSC TRIMMER X010
OSC TRIMMER X09
OSC TRIMMER X07
OSC TRIMMER X08

RECEIVE CIRCUIT ALIGNMENT

EQUIPMENT

1. General Electric Test Adaptor 4EX12A11.
2. A 138-174 MHz signal source.
3. A 21.4 MHz signal source (Used in setting frequency).
4. Volt/Ohmmeter (20,000 ohms/volt DC).
5. RF voltmeter.
6. Distortion Analyzer.

PRELIMINARY

1. Carefully remove back cover from radio (see Disassembly Procedure).
2. Connect test equipment as shown (see Receive Circuit Test Procedures).
3. Set output of 138-174 MHz signal source for approximately 50 millivolts.
4. Turn SQUELCH control fully clockwise.
5. Turn all RF tuning screws out of the casting.
6. If multiple frequency, place the channel select switch in the lowest frequency position.
7. Turn all equipment on.

ALIGNMENT PROCEDURE

STEP	TUNING CONTROL	PROCEDURE
		FREQUENCY MULTIPLIER (FX)
1	L3	With volt/ohmmeter between TEST PT and ground, tune L3 for a peak indication (approximately 0.6 VDC).
2	MULTIPLIER HELICALS L1, L2 & L3	With RF voltmeter between Pin 5 of the FX module and ground, tune MULTIPLIER HELICALS L1, L2 and L3 for maximum injection signal.
		RECEIVE CONVERTER (RC)
3	RF HELICALS L1, L2, L3 & L4	With an on-frequency signal tune RF HELICALS L1, L2, L3 and L4 for maximum quieting. Reduce the signal level as the quieting increases keeping the receive circuit out of limiting.
		FREQUENCY ADJUSTMENT
4	X0-1 through X0-10	While applying an on-frequency signal, loosely couple a 21.4 MHz signal to the converter. Adjust the oscillator trimmer(s) for a zero beat frequency between the two signals.

STEP 1

OUTPUT AND DISTORTION

Power output as follows:

1,000 microvolt test signal
by 1,000 hertz ±3.0 kHz

Volume Control for a 500 milli-
out (2 volts RMS).

tortion measurements according to
rer's instructions. Reading
less than 10% (5% is typical).
eceiver sensitivity is to be
, leave all controls and equip-
they are.

istortion is more than 5%, or
output is less than 0.5 watt,
lowing checks:

voltage---low voltage will cause
on. (Refer to Receiver Schematic
for voltages.)

in (Refer to Receiver Trouble-
Procedure).

STEP 2

VITY (12 dB SINAD)

1 checks out properly, measure
sensitivity as follows:

1000 microvolt, on-frequency
odulated by 1000 Hz with 3.0 kHz
n.

e RANGE switch on the Distortion
in the 200 to 2000 Hz distortion
sition (1000 Hz filter in the
. Tune the filter for minimum
or null on the lowest possible
00%, 30%, etc.)

e RANGE switch to the SET LEVEL
(filter out of the circuit) and
he input LEVEL control for a +2
ng on a mid range (30%).

ducing the signal generator out-
tch the RANGE control from SET
the distortion range until a
fference (+2 dB to -10 dB) is
between the SET LEVEL and
on range positions (filter out
er in).

B difference (Signal plus Noise
ortion to noise plus distortion
s the "usable" sensitivity level.
itivity should be less than rated
NAD specification with an audio
f at least 250 milliwatts.

l controls as they are and all
t connected if the Modulation
ce Bandwidth test is to be per-

ensitivity level is more than
SINAD, check the alignment of
s as directed in the Alignment
nd make the gain measurements as
Troubleshooting Procedure.

STEP 3

MODULATION ACCEPTANCE BANDWITH (IF BANDWITH)

TEST PROCEDURE

If STEPS 1 and 2 check out properly measure the bandwidth as follows:

A. Set the Signal Generator output for twice the microvolt reading obtained in the 12 dB SINAD measurement.

B. Set the RANGE control on the Distortion Analyzer in the SET LEVEL position (1000 Hz filter out of the circuit), and adjust the input LEVEL control for a +2 dB reading on the 30% range.

C. While increasing the deviation of the Signal Generator, switch the RANGE control from SET LEVEL to distortion range until a 12 dB difference is obtained between the SET LEVEL and distortion range readings (from +2 dB to -10 dB).

D. The deviation control reading for the 12 dB difference is the Modulation Acceptance Bandwidth of the receiver. It should be more than ±7 kHz (but less than ±9 kHz).

SERVICE CHECK

If the Modulation Acceptance Bandwidth test does not indicate the proper width, make gain measurements as shown on the Receiver Troubleshooting Procedure.

19D429618

TH
19

1.

T 2.
F THIS
2. THE CG
EN, THE
3.

TION #9
4. TALLED

OSITION
IS .5,
FREQ
WILL BE
8.

L PER

ACT PIN POSITION	
IN Hz	

MEPLATE
280529
LLED FOR ON
DEX)
3 Hz
COVER
19D429521P1
O

CHANNEL GUARD

PROGRAMMING PROCEDURE

TEST PROCEDURES

These Test Procedures are designed to help you to service a receiver that is operating --- but not properly. The problems encountered could be low audio, poor sensitivity, distortion, and low gain. By following the sequence of test steps starting with Step 1, the defect can be quickly localized.

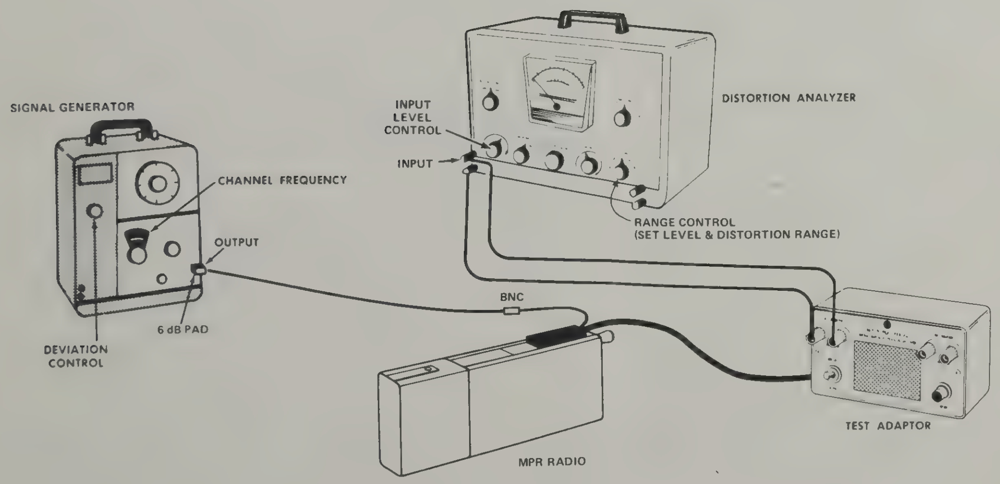
Once the defective stage is pin-pointed, refer to the "Service Check" listed to correct the problem. Additional corrective measures are included in the Troubleshooting Procedure. Before starting with the Receiver Test Procedures, be sure the receiver is tuned and aligned to the proper operating frequency.

TEST EQUIPMENT REQUIRED

- Distortion Analyzer
- Signal Generator
- 6 dB attenuation pad
- Test Adaptor Model 4EX12A11

PRELIMINARY ADJUSTMENTS

1. Connect the test equipment to the receiver as shown for all steps of the receiver Test Procedure.
2. Turn the SQUELCH control fully clockwise for all steps of the Test Procedure.
3. Turn on all of the equipment and let it warm up for 20 minutes.



RC-4117

RECEIVE CIRCUIT TEST PROCEDURES

STEP 1

AUDIO POWER OUTPUT AND DISTORTION

TEST PROCEDURE

Measure Audio Power output as follows:

A. Connect a 1,000 microvolt test signal modulated by 1,000 hertz ±3.0 kHz deviation.

B. Set the Volume Control for a 500 milliwatt output (2 volts RMS).

C. Make distortion measurements according to manufacturer's instructions. Reading should be less than 10% (5% is typical). If the receiver sensitivity is to be measured, leave all controls and equipment as they are.

SERVICE CHECK

If the distortion is more than 5%, or maximum audio output is less than 0.5 watt, make the following checks:

D. Battery voltage---low voltage will cause distortion. (Refer to Receiver Schematic Diagram for voltages.)

E. Audio Gain (Refer to Receiver Troubleshooting Procedure).

STEP 2

USABLE SENSITIVITY (12 dB SINAD)

TEST PROCEDURE

If STEP 1 checks out properly, measure the receiver sensitivity as follows:

A. Apply a 1000 microvolt, on-frequency signal modulated by 1000 Hz with 3.0 kHz deviation.

B. Place the RANGE switch on the Distortion Analyzer in the 200 to 2000 Hz distortion range position (1000 Hz filter in the circuit). Tune the filter for minimum reading or null on the lowest possible scale (100%, 30%, etc.)

C. Place the RANGE switch to the SET LEVEL position (filter out of the circuit) and adjust the input LEVEL control for a +2 dB reading on a mid range (30%).

D. While reducing the signal generator output, switch the RANGE control from SET LEVEL to the distortion range until a 12 dB difference (+2 dB to -10 dB) is obtained between the SET LEVEL and distortion range positions (filter out and filter in).

E. The 12 dB difference (Signal plus Noise and Distortion to noise plus distortion ratio) is the "usable" sensitivity level. The sensitivity should be less than rated 12 dB SINAD specification with an audio output of at least 250 milliwatts.

F. Leave all controls as they are and all equipment connected if the Modulation Acceptance Bandwidth test is to be performed.

SERVICE CHECK

If the sensitivity level is more than rated 12 dB SINAD, check the alignment of the RF stages as directed in the Alignment Procedure, and make the gain measurements as shown on the Troubleshooting Procedure.

STEP 3

MODULATION ACCEPTANCE BANDWIDTH (IF BANDWITH)

TEST PROCEDURE

If STEPS 1 and 2 check out properly measure the bandwidth as follows:

A. Set the Signal Generator output for twice the microvolt reading obtained in the 12 dB SINAD measurement.

B. Set the RANGE control on the Distortion Analyzer in the SET LEVEL position (1000 Hz filter out of the circuit), and adjust the input LEVEL control for a +2 dB reading on the 30% range.

C. While increasing the deviation of the Signal Generator, switch the RANGE control from SET LEVEL to distortion range until a 12 dB difference is obtained between the SET LEVEL and distortion range readings (from +2 dB to -10 dB).

D. The deviation control reading for the 12 dB difference is the Modulation Acceptance Bandwidth of the receiver. It should be more than ±7 kHz (but less than ±9 kHz).

SERVICE CHECK

If the Modulation Acceptance Bandwidth test does not indicate the proper width, make gain measurements as shown on the Receiver Troubleshooting Procedure.

THESE INSTRUCTIONS COVER THE FREQ CODING FOR C. G. MODULE 19D429618 USING THE STANDARD C. G. FREQ.

1. INSTALL CONTACT PINS (19B219681), PER FIG. 1, IN POSITIONS INDICATED BY "X" IN CHART 1, WHICH AGREES WITH DESIRED CG FREQ. (NOTE - EXAMPLE SHOWN FOR 127.3Hz).
2. ASSEMBLE SNAP ON COVER (19D429521P1).
3. BREAK OFF CONTACT TABS ABOVE COVER BY BENDING TOWARD EITHER END OF MODULE. (DO NOT BEND TAB TOWARD SIDE OF MODULE).
4. STAMP APPROPRIATE CG FREQ ON LABEL (NP280529) AND ASSEMBLE IN RECESS ON TOP OF COVER. (EXAMPLE 127.3)

CHART 1

FREQ CHART										
C.G.. FREQ	CONTACT PIN POSITION									
	9	8	7	6	5	4	3	2	1	0
67	X		X	X	X	X			X	X
71.9	X		X	X		X	X	X	X	X
77	X		X	X			X		X	X
82.5	X		X		X	X		X		X
88.5	X		X			X	X	X		X
94.8	X		X					X		
100	X			X	X		X	X	X	X
103.5	X			X	X					X
107.2	X			X		X			X	
110.9	X			X					X	X
114.8	X				X	X		X		
118.8	X				X			X		
123	X					X			X	X
127.3	X								X	
131.8		X	X	X	X	X				
136.5		X	X	X		X	X	X		X
141.3		X	X	X			X		X	
146.2		X	X		X	X		X	X	
151.4		X	X		X					X
156.7		X	X				X	X		
162.2		X		X	X	X		X	X	
167.9		X		X		X	X	X	X	X
173.8		X		X			X			
179.9		X			X		X	X	X	X
186.2		X				X		X	X	
192.8			X	X	X	X	X	X		
203.5			X	X		X				X
210.7			X		X	X		X		

THESE INSTRUCTIONS COVER THE FREQ CODING FOR CG MODULE 19D429618 USING THE NON STANDARD CG FREQ.

1. USE CHART 2 TO CALCULATE THE CG FREQ DESIRED.
2. FIND THE FREQ DESIRED BY ADDING UP THE FREQ IN CHART 2. ABOVE EACH FREQ IS A CONTACT PIN POSITION NUMBER, IF THIS POSITION IS OPEN (THAT IS A PIN IS NOT INSTALLED), THE CG WILL PRODUCE THAT FREQ. IF MORE THAN ONE IS LEFT OPEN, THE OUTPUT FREQ WILL BE THE SUM OF THE OPEN POSITIONS.

   EXAMPLE: CG FREQ 128Hz THEREFORE CONTACT PIN POSITION #9 WILL BE OPEN AND CONTACT PINS WILL BE INSTALLED IN POSITION 0, 1, 2, 3, 4, 5, 6 ,7 AND 8.

   EXAMPLE: CG FREQ 132.75Hz. THEREFORE CONTACT PIN POSITION #9 WHICH IS 128, #4 WHICH IS 4, #1 WHICH IS .5, AND #0 WHICH IS .25 WILL BE OPEN. ADD THE FREQ 128 + 4 + .5 + .25 = 132.75. CONTACT PINS WILL BE INSTALLED IN POSITION #2, 3, 5, 6, 7 AND 8.
3. INSTALL CONTACT PINS, ASSEMBLE COVER AND STAMP LABEL PER INSTRUCTIONS FOR FREQ CODING THE STANDARD CG FREQ.

CHART 2

9	8	7	6	5	4	3	2	1	0	CONTACT PIN POSITION
128	64	32	16	8	4	2	1	.5	.25	FREQ IN Hz

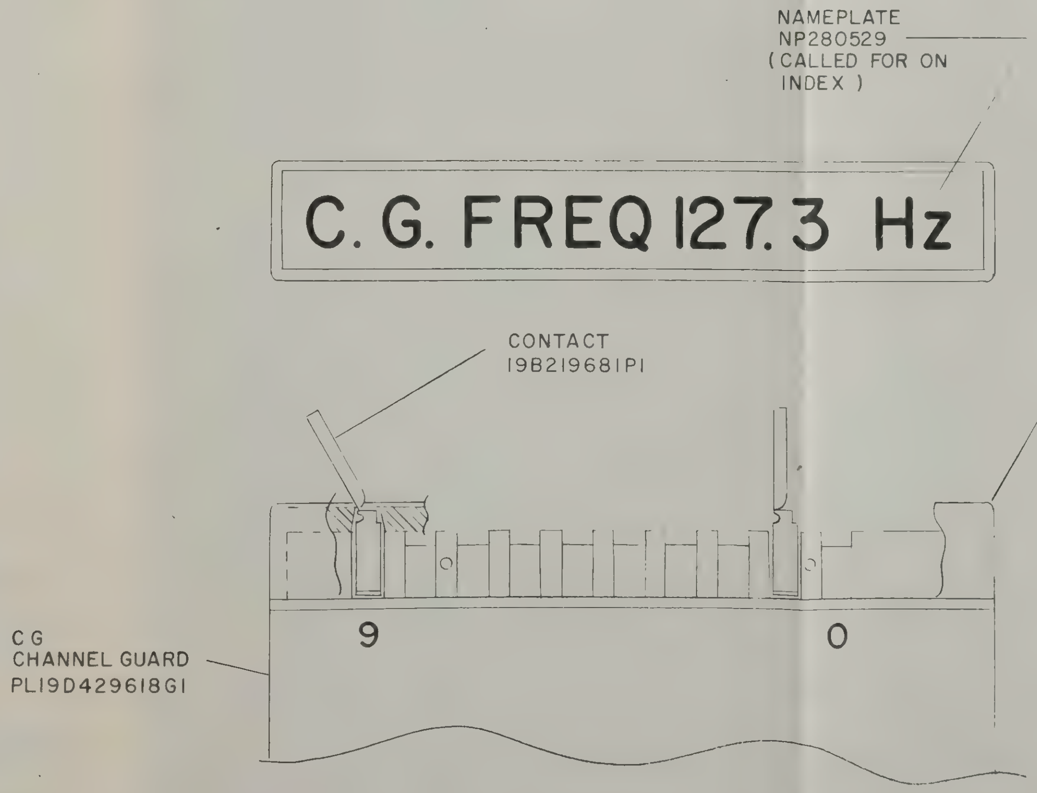


FIG. 1

CHANNEL GUARD

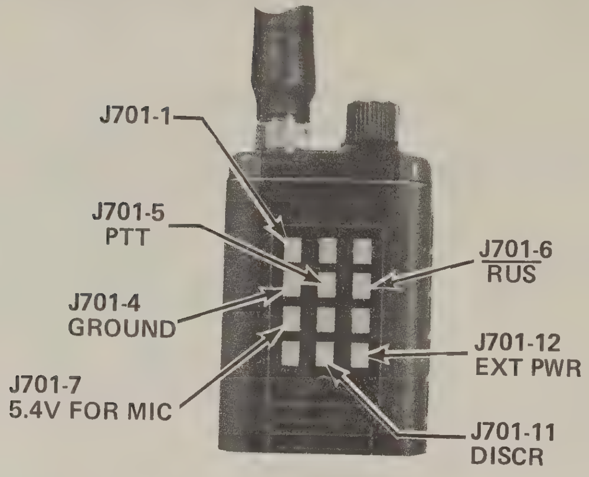
PROGRAMMING PROCEDURE

(19D429867, Sh. 3, Rev. 0)

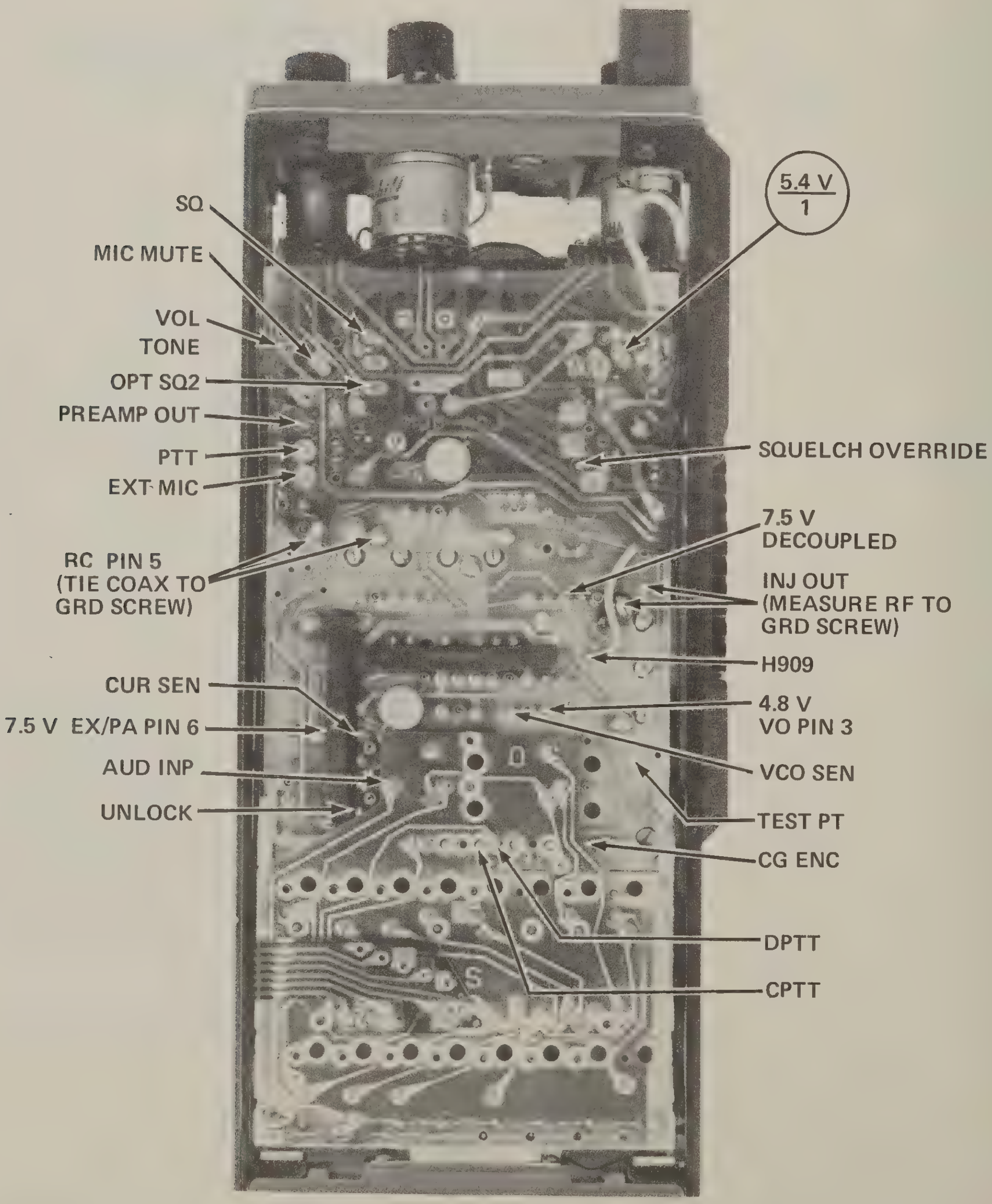
LOW/NO → SECTION B

OK → SECTION 6

UDC JACK (J701) CONNECTION


J701-1
J701-5
PTT
J701-4
GROUND
J701-7
5.4V FOR MIC
J701-6
RUS
J701-12
EXT PWR
J701-11
DISCR

MPR SERVICE TEST POINTS


SQ
MIC MUTE
VOL
TONE
OPT SQ2
PREAMP OUT
PTT
EXT MIC
RC PIN 5
(TIE COAX TO
GRD SCREW)
CUR SEN
7.5 V EX/PA PIN 6
AUD INP
UNLOCK
5.4 V
1
SQUELCH OVERRIDE
7.5 V
DECOUPLED
INJ OUT
(MEASURE RF TO
GRD SCREW)
H909
4.8 V
VO PIN 3
VCO SEN
TEST PT
CG ENC
DPTT
CPTT

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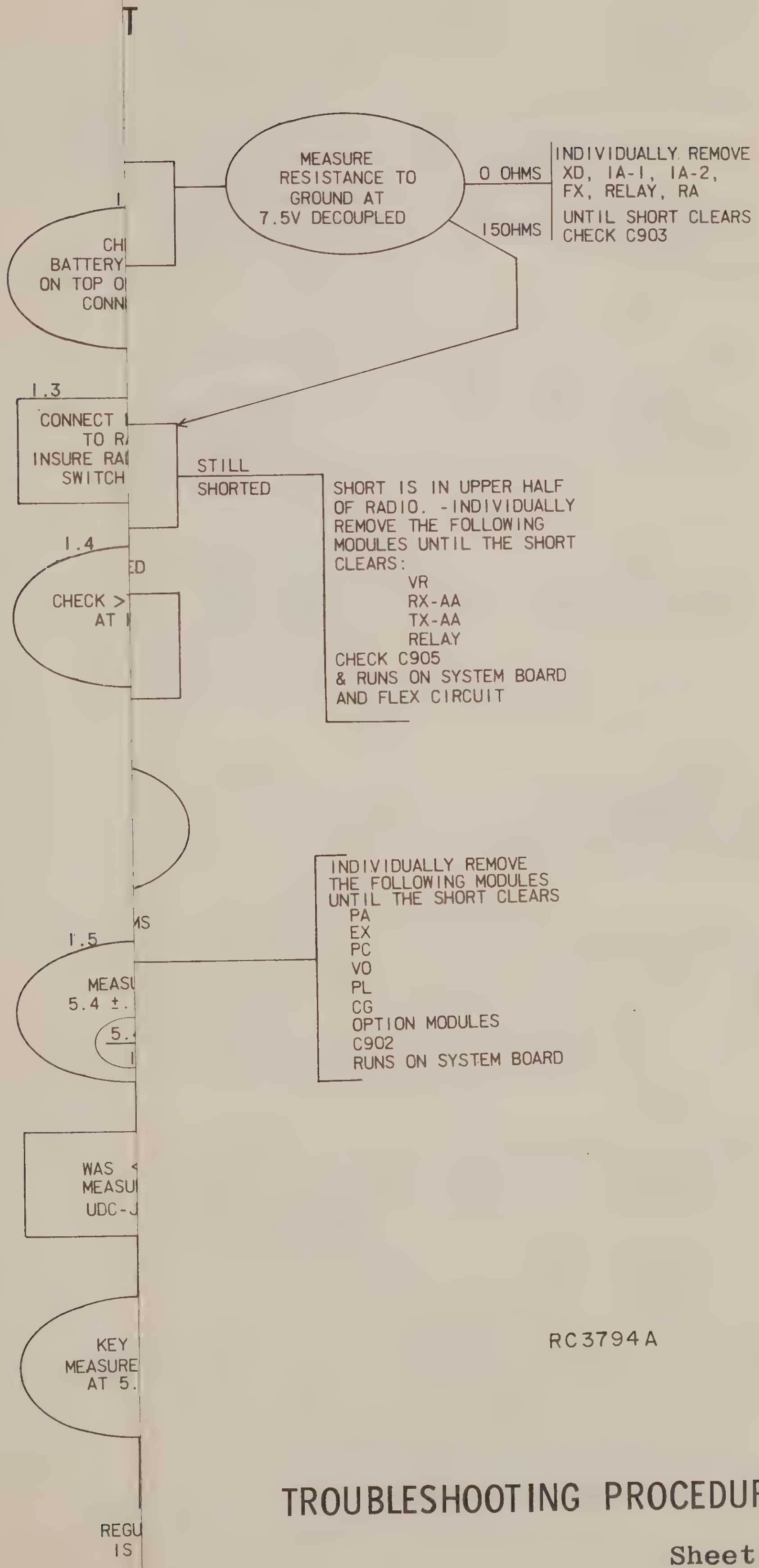

T
MEASURE RESISTANCE TO GROUND AT 7.5V DECOUPLED
0 OHMS
INDIVIDUALLY REMOVE XD, IA-1, IA-2, FX, RELAY, RA
UNTIL SHORT CLEARS CHECK C903
15OHMS
1
CH
BATTERY
ON TOP O
CONN
1.3
CONNECT
TO R
INSURE RA
SWITCH
STILL SHORTED
SHORT IS IN UPPER HALF OF RADIO. -INDIVIDUALLY REMOVE THE FOLLOWING MODULES UNTIL THE SHORT CLEARS:
VR
RX-AA
TX-AA
RELAY
CHECK C905
& RUNS ON SYSTEM BOARD AND FLEX CIRCUIT
1.4
ED
CHECK >
AT
INDIVIDUALLY REMOVE THE FOLLOWING MODULES UNTIL THE SHORT CLEARS
PA
EX
PC
VO
PL
CG
OPTION MODULES
C902
RUNS ON SYSTEM BOARD
MS
1.5
MEAS
5.4 ±.
5.
WAS
MEASU
UDC-J
KEY
MEASURE
AT 5.
REGU
IS

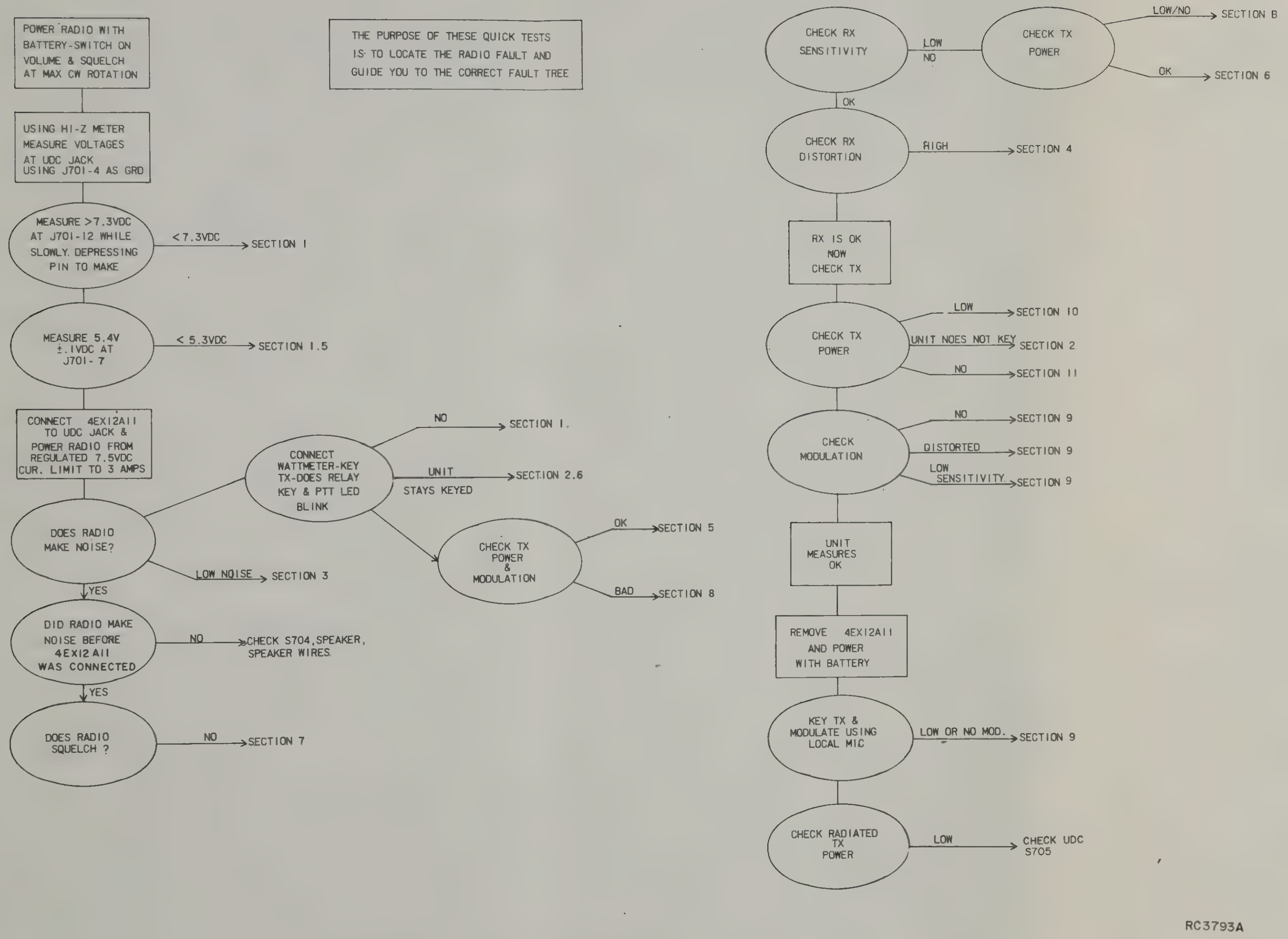
RC3794A

TROUBLESHOOTING PROCEDURE

Sheet 2

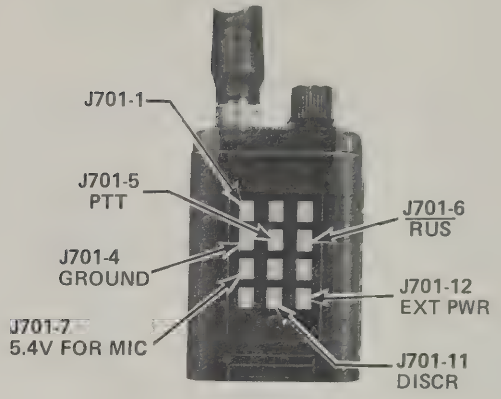
Issue 1

MPR TROUBLESHOOTING TREE

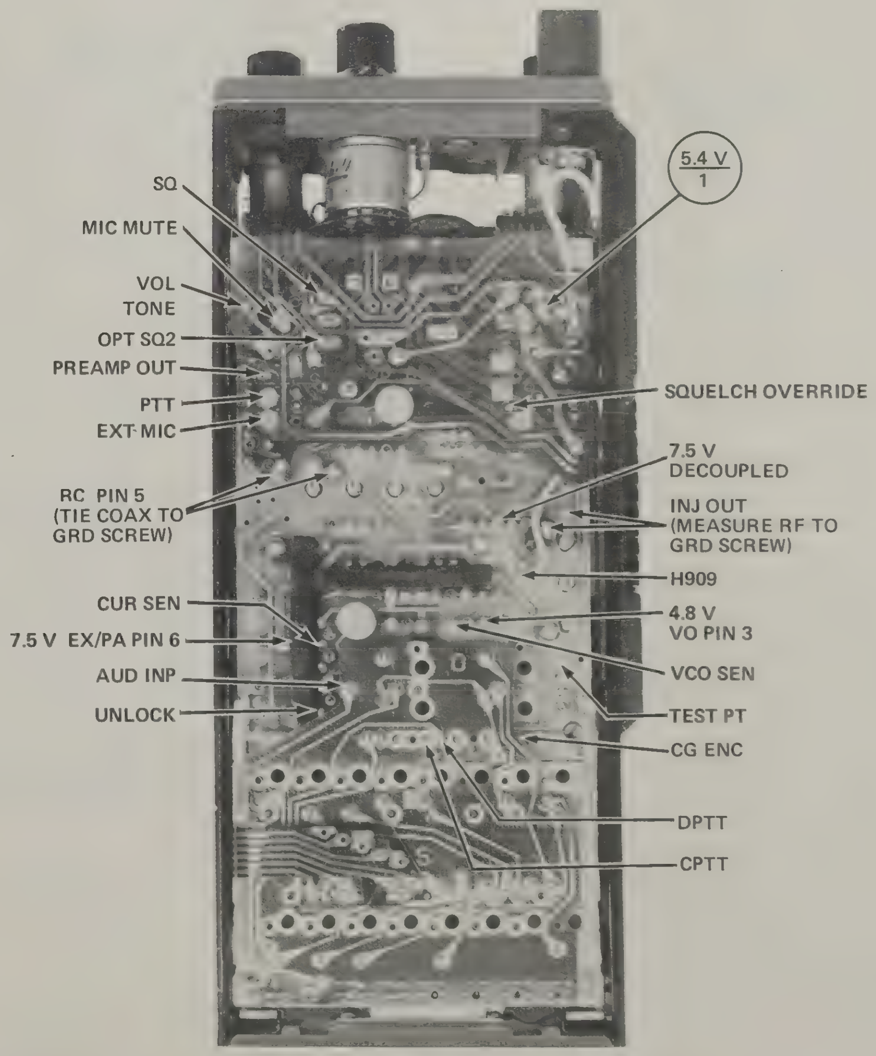

THE PURPOSE OF THESE QUICK TESTS IS TO LOCATE THE RADIO FAULT AND GUIDE YOU TO THE CORRECT FAULT TREE

POWER RADIO WITH BATTERY-SWITCH ON VOLUME & SQUELCH AT MAX CW ROTATION
USING HI-Z METER MEASURE VOLTAGES AT UDC JACK USING J701-4 AS GRD
MEASURE >7.3VDC AT J701-12 WHILE SLOWLY DEPRESSING PIN TO MAKE
< 7.3VDC
SECTION 1
MEASURE 5.4V ±.1VDC AT J701-7
< 5.3VDC
SECTION 1.5
CONNECT 4EX12A11 TO UDC JACK & POWER RADIO FROM REGULATED 7.5VDC CUR. LIMIT TO 3 AMPS
DOES RADIO MAKE NOISE?
LOW NOISE
SECTION 3
YES
DID RADIO MAKE NOISE BEFORE 4EX12A11 WAS CONNECTED
NO
CHECK S704, SPEAKER, SPEAKER WIRES.
YES
DOES RADIO SQUELCH ?
NO
SECTION 7
CONNECT WATTMETER-KEY TX-DOES RELAY KEY & PTT LED BLINK
NO
SECTION 1.
UNIT STAYS KEYED
SECTION 2.6
CHECK TX POWER & MODULATION
OK
SECTION 5
BAD
SECTION 8
CHECK RX SENSITIVITY
LOW NO
CHECK TX POWER
LOW/NO
SECTION B
OK
SECTION 6
OK
CHECK RX DISTORTION
HIGH
SECTION 4
RX IS OK NOW CHECK TX
CHECK TX POWER
LOW
SECTION 10
UNIT NOES NOT KEY
SECTION 2
NO
SECTION 11
CHECK MODULATION
NO
SECTION 9
DISTORTED
SECTION 9
LOW SENSITIVITY
SECTION 9
UNIT MEASURES OK
REMOVE 4EX12A11 AND POWER WITH BATTERY
KEY TX & MODULATE USING LOCAL MIC
LOW OR NO MOD.
SECTION 9
CHECK RADIATED TX POWER
LOW
CHECK UDC S705
RC3793A

UDC JACK (J701) CONNECTION


J701-1
J701-5 PTT
J701-4 GROUND
J701-7 5.4V FOR MIC
J701-6 RUS
J701-12 EXT PWR
J701-11 DISCR

MPR SERVICE TEST POINTS

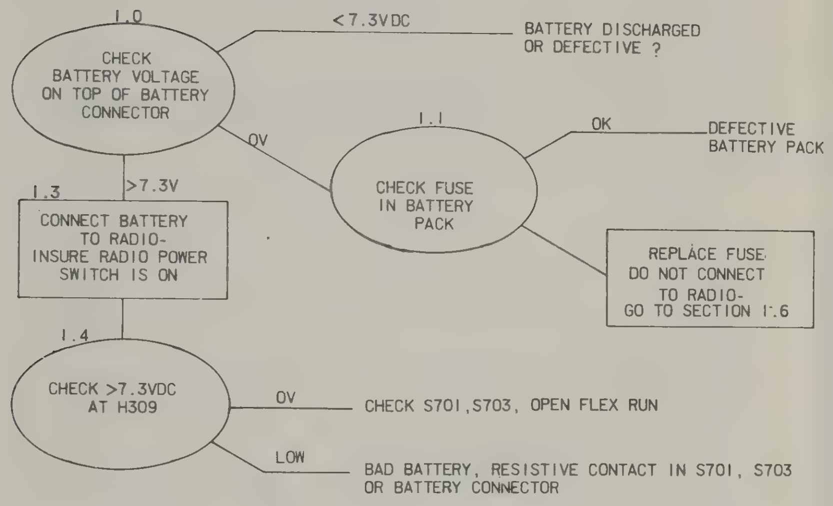

SQ
MIC MUTE
VOL
TONE
OPT SQ2
PREAMP OUT
PTT
EXT MIC
RC PIN 5 (TIE COAX TO GRD SCREW)
CUR SEN
7.5 V EX/PA PIN 6
AUD INP
UNLOCK
5.4 V 1
SQUELCH OVERRIDE
7.5 V DECOUPLED
INJ OUT (MEASURE RF TO GRD SCREW)
H909
4.8 V VO PIN 3
VCO SEN
TEST PT
CG ENC
DPTT
CPTT

MPR TROUBLESHOOTING PROCEDURE

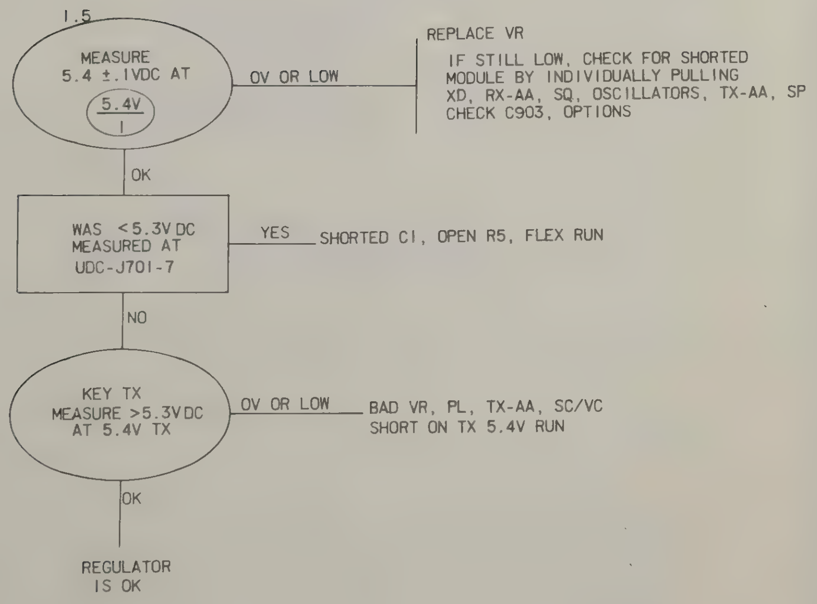
Sheet 1

Issue 2

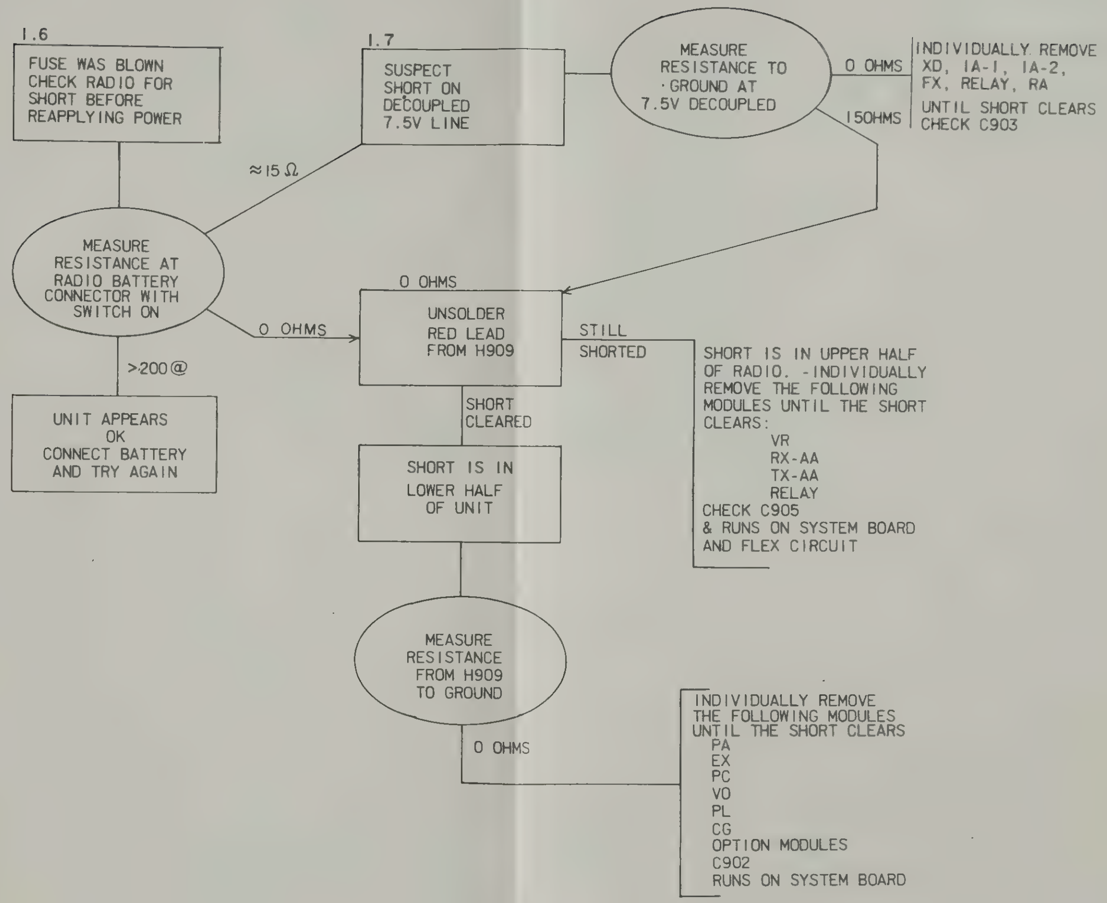
SECTION #1
POWER DISTRIBUTION FAULT


1.0
CHECK BATTERY VOLTAGE ON TOP OF BATTERY CONNECTOR
<7.3VDC
BATTERY DISCHARGED OR DEFECTIVE ?
0V
1.1
CHECK FUSE IN BATTERY PACK
OK
DEFECTIVE BATTERY PACK
REPLACE FUSE DO NOT CONNECT TO RADIO- GO TO SECTION 1.6
>7.3V
1.3
CONNECT BATTERY TO RADIO- INSURE RADIO POWER SWITCH IS ON
1.4
CHECK >7.3VDC AT H309
0V
CHECK S701, S703, OPEN FLEX RUN
LOW
BAD BATTERY, RESISTIVE CONTACT IN S701, S703 OR BATTERY CONNECTOR

REGULATOR FAULT
SECTION 1.5

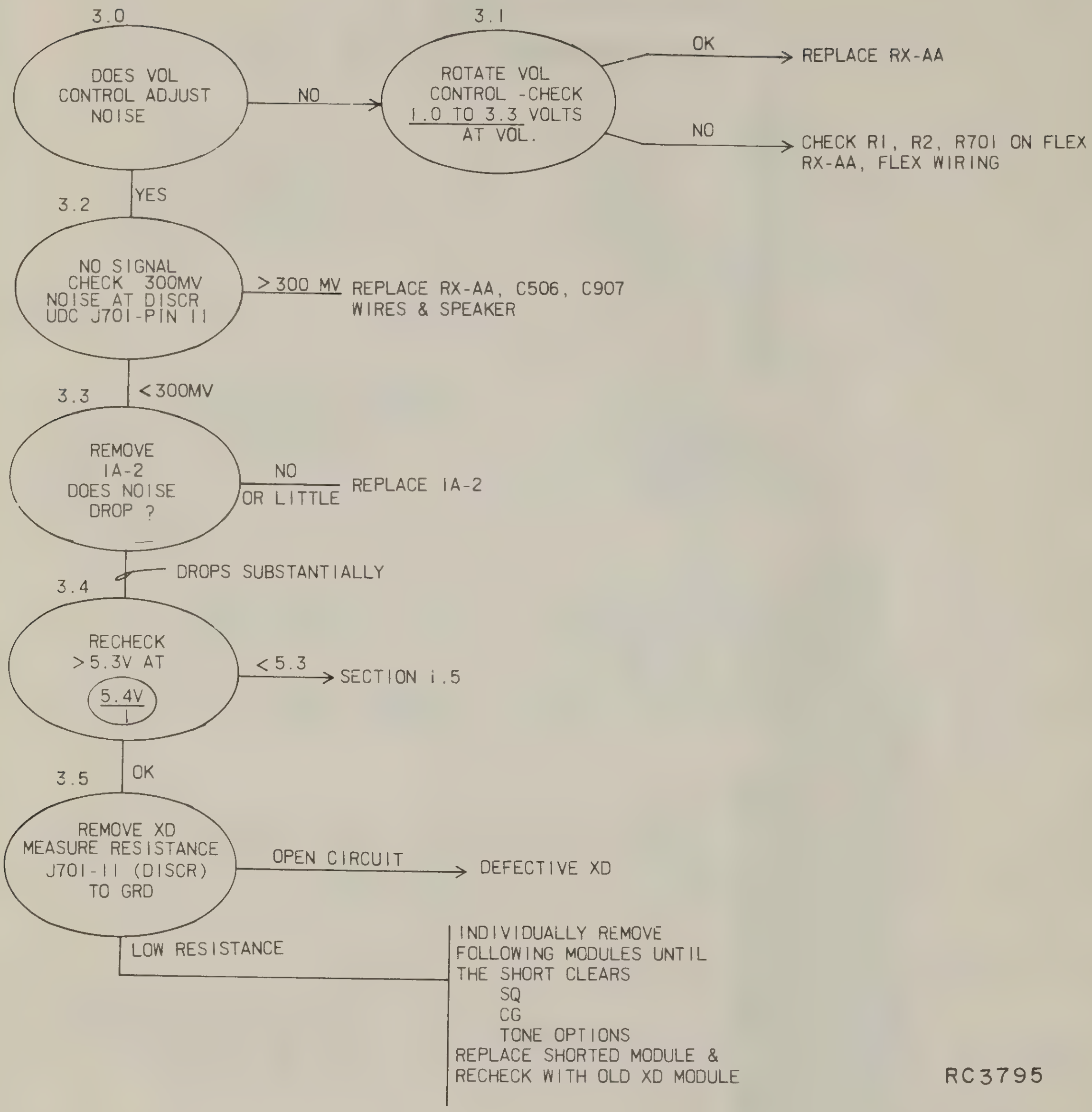

1.5
MEASURE 5.4 ±.1VDC AT 5.4V I
0V OR LOW
REPLACE VR
IF STILL LOW, CHECK FOR SHORTED MODULE BY INDIVIDUALLY PULLING XD, RX-AA, SQ, OSCILLATORS, TX-AA, SP CHECK C903, OPTIONS
OK
WAS <5.3V DC MEASURED AT UDC-J701-7
YES
SHORTED C1, OPEN R5, FLEX RUN
NO
KEY TX MEASURE >5.3VDC AT 5.4V TX
0V OR LOW
BAD VR, PL, TX-AA, SC/VC SHORT ON TX 5.4V RUN
OK
REGULATOR IS OK

LOCATING A SHORT
SECTION 1.6


1.6
FUSE WAS BLOWN CHECK RADIO FOR SHORT BEFORE REAPPLYING POWER
MEASURE RESISTANCE AT RADIO BATTERY CONNECTOR WITH SWITCH ON
≈15 Ω
1.7
SUSPECT SHORT ON DECOUPLED 7.5V LINE
MEASURE RESISTANCE TO GROUND AT 7.5V DECOUPLED
0 OHMS
INDIVIDUALLY REMOVE XD, IA-1, IA-2, FX, RELAY, RA
UNTIL SHORT CLEARS CHECK C903
15OHMS
>200@
UNIT APPEARS OK CONNECT BATTERY AND TRY AGAIN
0 OHMS
0 OHMS
UNSOLDER RED LEAD FROM H909
STILL SHORTED
SHORT IS IN UPPER HALF OF RADIO. -INDIVIDUALLY REMOVE THE FOLLOWING MODULES UNTIL THE SHORT CLEARS:
VR
RX-AA
TX-AA
RELAY
CHECK C905
& RUNS ON SYSTEM BOARD AND FLEX CIRCUIT
SHORT CLEARED
SHORT IS IN LOWER HALF OF UNIT
MEASURE RESISTANCE FROM H909 TO GROUND
0 OHMS
INDIVIDUALLY REMOVE THE FOLLOWING MODULES UNTIL THE SHORT CLEARS
PA
EX
PC
VO
PL
CG
OPTION MODULES
C902
RUNS ON SYSTEM BOARD

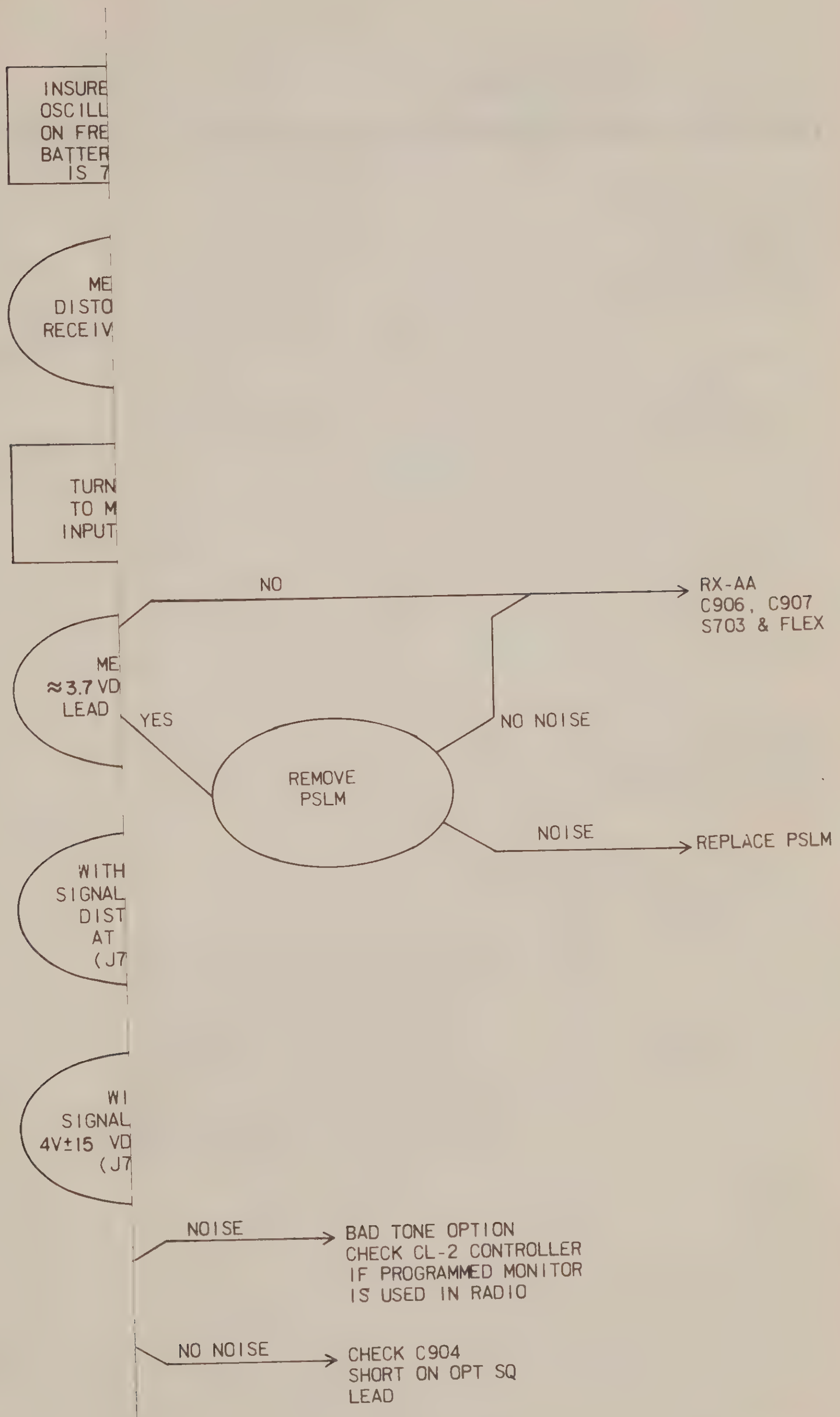
RC3794A

SECTION 3
RX AUDIO NOISE LOW


3.0
DOES VOL CONTROL ADJUST NOISE
NO
3.1
ROTATE VOL CONTROL -CHECK 1.0 TO 3.3 VOLTS AT VOL.
OK
REPLACE RX-AA
NO
CHECK R1, R2, R701 ON FLEX RX-AA, FLEX WIRING
YES
3.2
NO SIGNAL CHECK 300MV NOISE AT DISCR UDC J701-PIN 11
> 300 MV
REPLACE RX-AA, C506, C907 WIRES & SPEAKER
< 300MV
3.3
REMOVE IA-2 DOES NOISE DROP ?
NO OR LITTLE
REPLACE IA-2
DROPS SUBSTANTIALLY
3.4
RECHECK > 5.3V AT
5.4V
1
< 5.3
SECTION 1.5
OK
3.5
REMOVE XD MEASURE RESISTANCE J701-11 (DISCR) TO GRD
OPEN CIRCUIT
DEFECTIVE XD
LOW RESISTANCE
INDIVIDUALLY REMOVE FOLLOWING MODULES UNTIL THE SHORT CLEARS
SQ
CG
TONE OPTIONS
REPLACE SHORTED MODULE & RECHECK WITH OLD XD MODULE

RC3795

RECEIVER

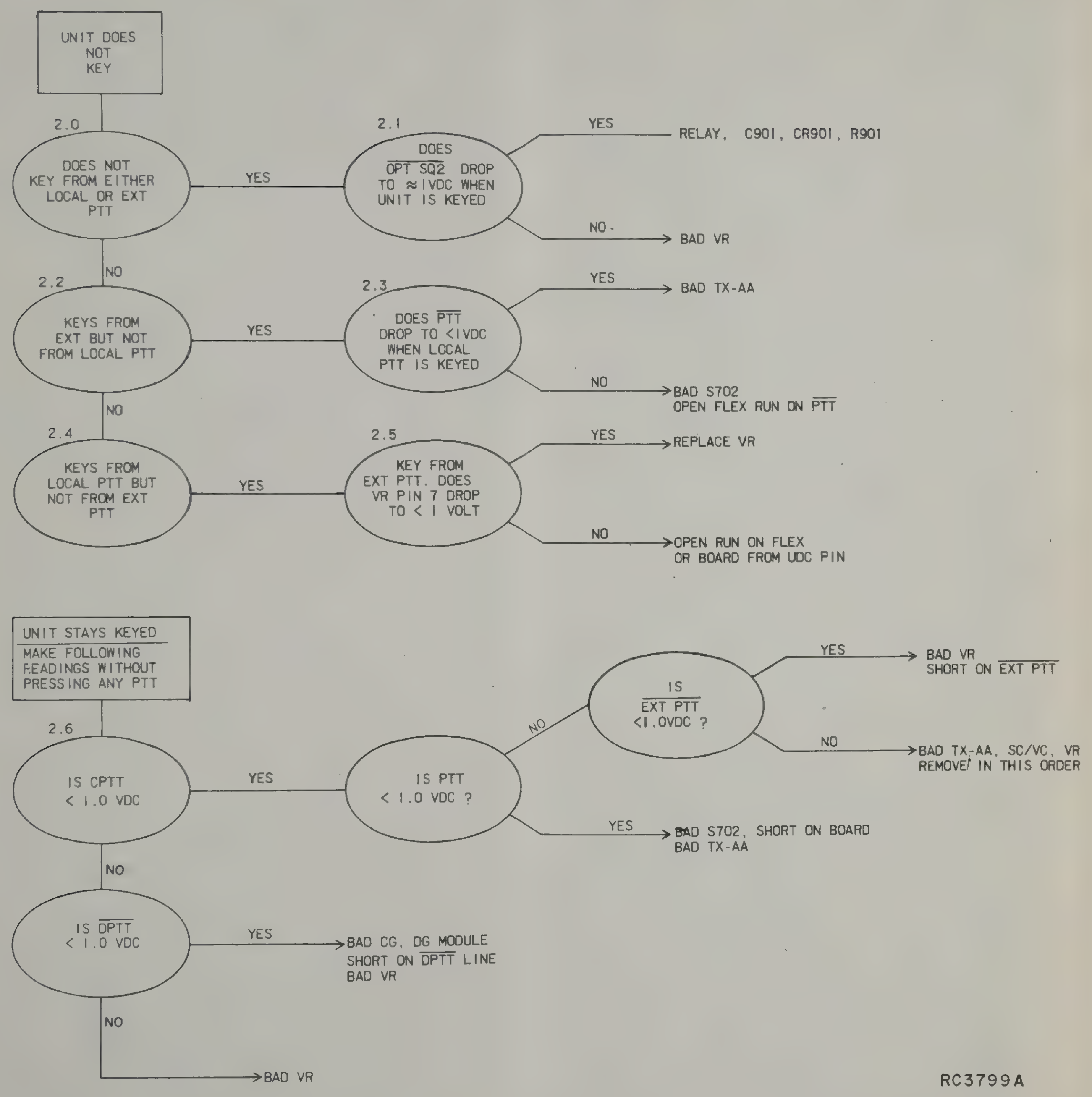

INSURE
OSCILL
ON FRE
BATTER
IS 7
ME
DISTO
RECEIV
TURN
TO M
INPUT
ME
≈3.7 VD
LEAD
NO
YES
RX-AA
C906, C907
S703 & FLEX
REMOVE
PSLM
NO NOISE
NOISE
REPLACE PSLM
WITH
SIGNAL
DIST
AT
(J7
WI
SIGNAL
4V±15 VD
(J7
NOISE
BAD TONE OPTION
CHECK CL-2 CONTROLLER
IF PROGRAMMED MONITOR
IS USED IN RADIO
NO NOISE
CHECK C904
SHORT ON OPT SQ
LEAD

RC3797A

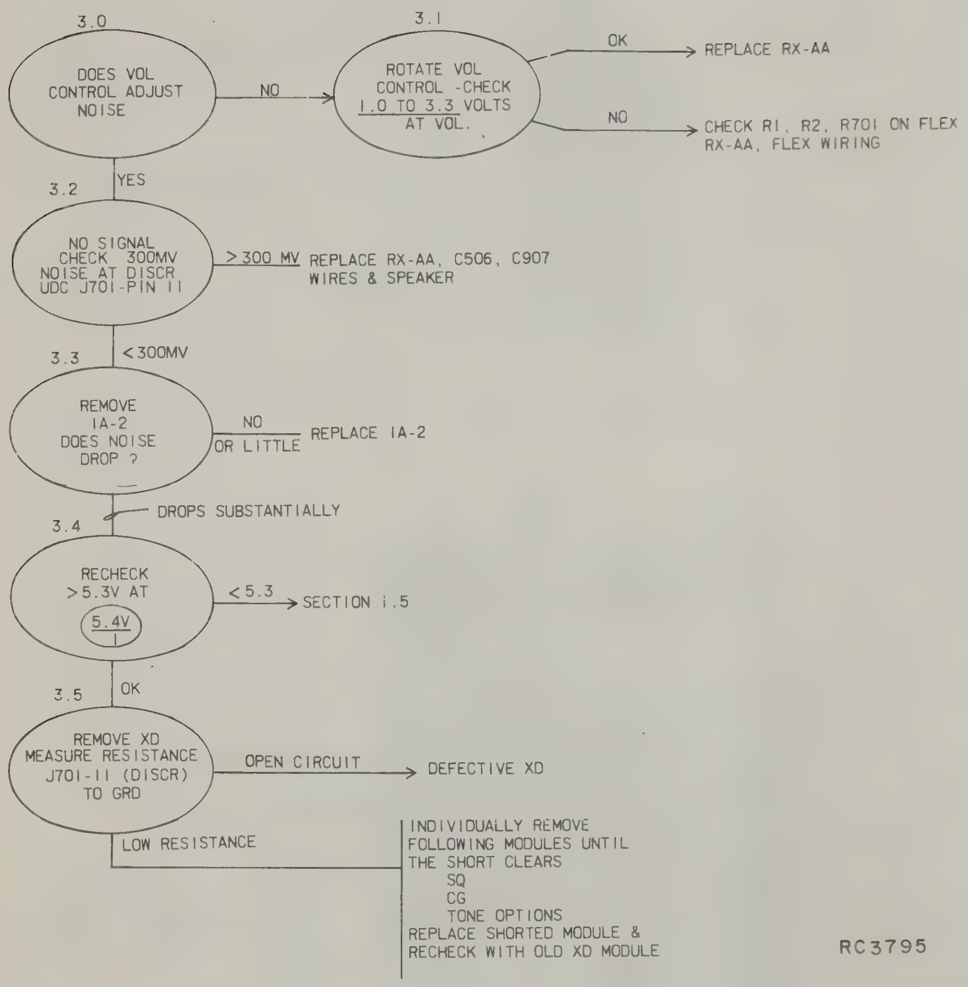
TROUBLESHOOTING PROCEDURE

Sheet 4

SECTION 2
TRANSMITTER KEYING FAILURE


UNIT DOES NOT KEY
2.0
DOES NOT KEY FROM EITHER LOCAL OR EXT PTT
YES
2.1
DOES OPT SQ2 DROP TO ≈1VDC WHEN UNIT IS KEYED
YES
RELAY, C901, CR901, R901
NO
BAD VR
NO
2.2
KEYS FROM EXT BUT NOT FROM LOCAL PTT
YES
2.3
DOES PTT DROP TO <1VDC WHEN LOCAL PTT IS KEYED
YES
BAD TX-AA
NO
BAD S702
OPEN FLEX RUN ON PTT
NO
2.4
KEYS FROM LOCAL PTT BUT NOT FROM EXT PTT
YES
2.5
KEY FROM EXT PTT. DOES VR PIN 7 DROP TO < 1 VOLT
YES
REPLACE VR
NO
OPEN RUN ON FLEX OR BOARD FROM UDC PIN
UNIT STAYS KEYED
MAKE FOLLOWING READINGS WITHOUT PRESSING ANY PTT
2.6
IS CPTT < 1.0 VDC
YES
IS PTT < 1.0 VDC ?
NO
IS EXT PTT <1.0VDC ?
YES
BAD VR
SHORT ON EXT PTT
NO
BAD TX-AA, SC/VC, VR
REMOVE IN THIS ORDER
YES
BAD S702, SHORT ON BOARD
BAD TX-AA
NO
IS DPTT < 1.0 VDC
YES
BAD CG, DG MODULE
SHORT ON DPTT LINE
BAD VR
NO
BAD VR
RC3799A

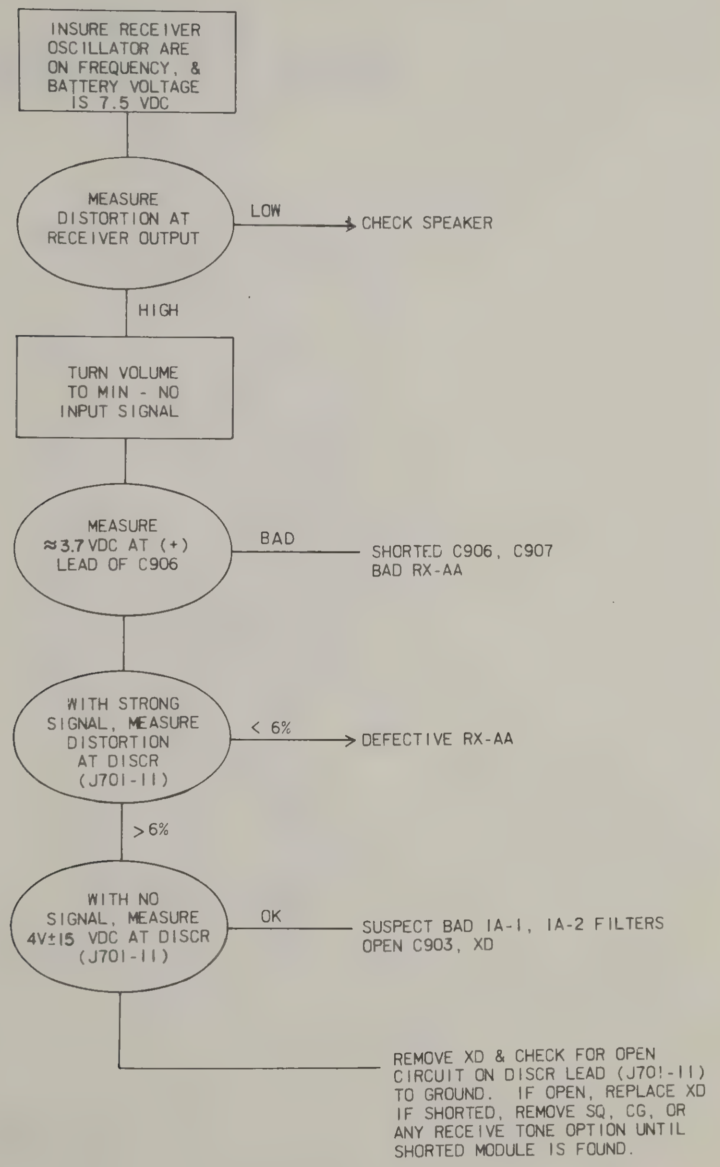
SECTION 3
RX AUDIO NOISE LOW


3.0
DOES VOL CONTROL ADJUST NOISE
NO
3.1
ROTATE VOL CONTROL -CHECK 1.0 TO 3.3 VOLTS AT VOL.
OK
REPLACE RX-AA
NO
CHECK R1, R2, R701 ON FLEX
RX-AA, FLEX WIRING
YES
3.2
NO SIGNAL CHECK 300MV NOISE AT DISCR UDC J701-PIN 11
> 300 MV
REPLACE RX-AA, C506, C907
WIRES & SPEAKER
< 300MV
3.3
REMOVE IA-2 DOES NOISE DROP ?
NO OR LITTLE
REPLACE IA-2
DROPS SUBSTANTIALLY
3.4
RECHECK > 5.3V AT 5.4V 1
< 5.3
SECTION 1.5
OK
3.5
REMOVE XD MEASURE RESISTANCE J701-11 (DISCR) TO GRD
OPEN CIRCUIT
DEFECTIVE XD
LOW RESISTANCE
INDIVIDUALLY REMOVE FOLLOWING MODULES UNTIL THE SHORT CLEARS
SQ
CG
TONE OPTIONS
REPLACE SHORTED MODULE & RECHECK WITH OLD XD MODULE
RC3795

TROUBLESHOOTING PROCEDURE

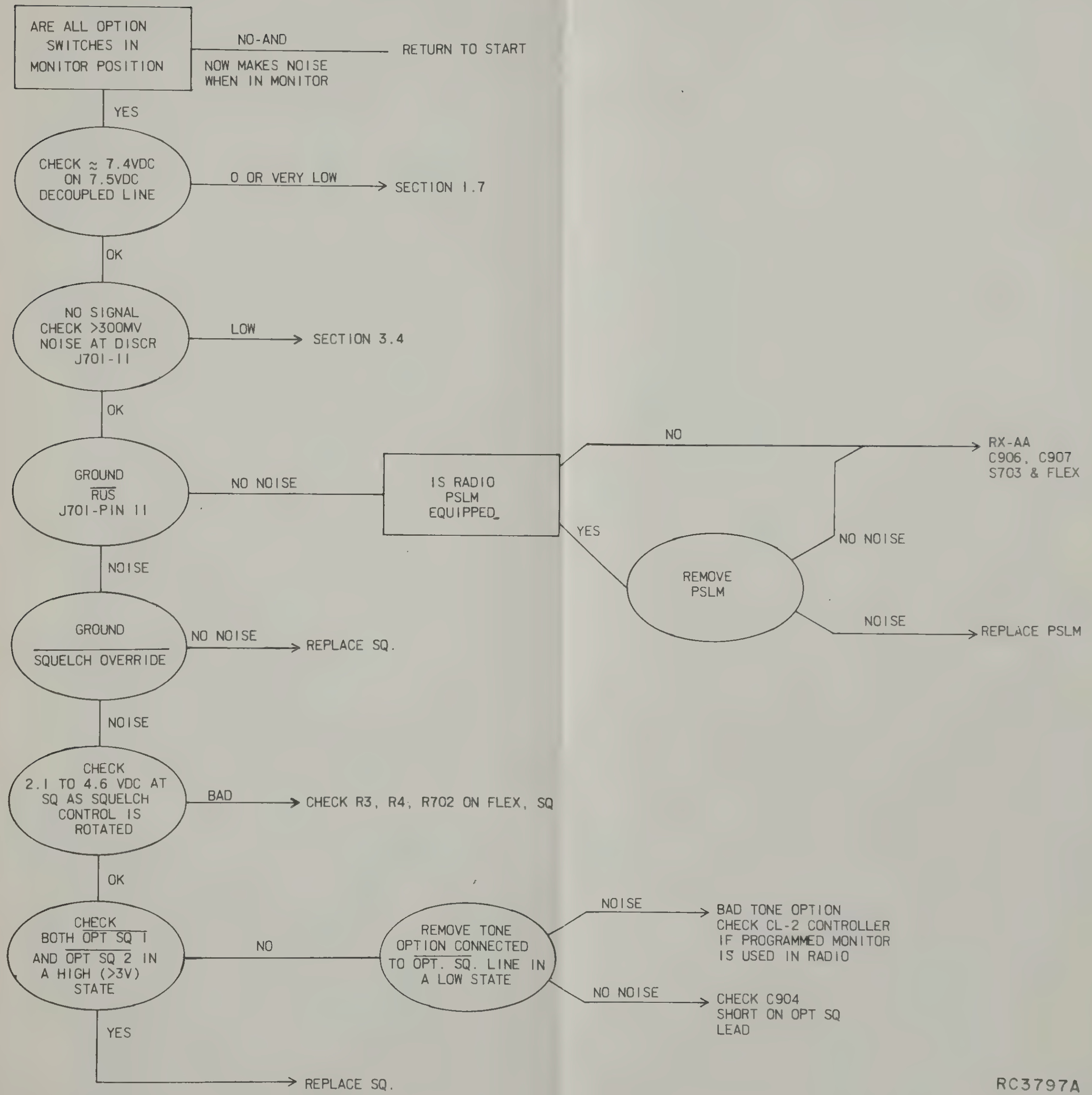
Sheet 3

SECTION 4
RECEIVER AUDIO DISTORTED


INSURE RECEIVER OSCILLATOR ARE ON FREQUENCY, & BATTERY VOLTAGE IS 7.5 VDC
MEASURE DISTORTION AT RECEIVER OUTPUT
LOW
CHECK SPEAKER
HIGH
TURN VOLUME TO MIN - NO INPUT SIGNAL
MEASURE ≈3.7 VDC AT (+) LEAD OF C906
BAD
SHORTED C906, C907 BAD RX-AA
WITH STRONG SIGNAL, MEASURE DISTORTION AT DISCR (J701-11)
< 6%
DEFECTIVE RX-AA
> 6%
WITH NO SIGNAL, MEASURE 4V±15 VDC AT DISCR (J701-11)
OK
SUSPECT BAD IA-1, IA-2 FILTERS OPEN C903, XD
REMOVE XD & CHECK FOR OPEN CIRCUIT ON DISCR LEAD (J701-11) TO GROUND. IF OPEN, REPLACE XD IF SHORTED, REMOVE SQ, CG, OR ANY RECEIVE TONE OPTION UNTIL SHORTED MODULE IS FOUND.

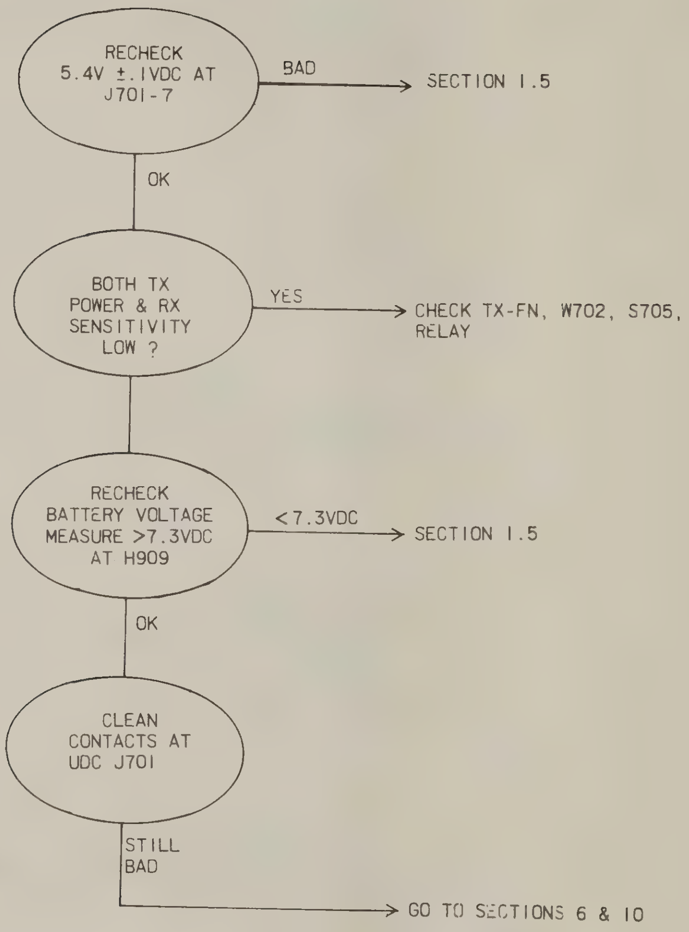
RC3796A

SECTION 5
NO RECEIVER AUDIO


ARE ALL OPTION SWITCHES IN MONITOR POSITION
NO-AND
NOW MAKES NOISE WHEN IN MONITOR
RETURN TO START
YES
CHECK ≈ 7.4VDC ON 7.5VDC DECOUPLED LINE
0 OR VERY LOW
SECTION 1.7
OK
NO SIGNAL CHECK >300MV NOISE AT DISCR J701-11
LOW
SECTION 3.4
OK
GROUND RUS J701-PIN 11
NO NOISE
IS RADIO PSLM EQUIPPED
NO
RX-AA C906, C907 S703 & FLEX
YES
REMOVE PSLM
NO NOISE
NOISE
REPLACE PSLM
NOISE
GROUND SQUELCH OVERRIDE
NO NOISE
REPLACE SQ.
NOISE
CHECK 2.1 TO 4.6 VDC AT SQ AS SQUELCH CONTROL IS ROTATED
BAD
CHECK R3, R4, R702 ON FLEX, SQ
OK
CHECK BOTH OPT SQ 1 AND OPT SQ 2 IN A HIGH (>3V) STATE
NO
REMOVE TONE OPTION CONNECTED TO OPT. SQ. LINE IN A LOW STATE
NOISE
BAD TONE OPTION CHECK CL-2 CONTROLLER IF PROGRAMMED MONITOR IS USED IN RADIO
NO NOISE
CHECK C904 SHORT ON OPT SQ LEAD
YES
REPLACE SQ.

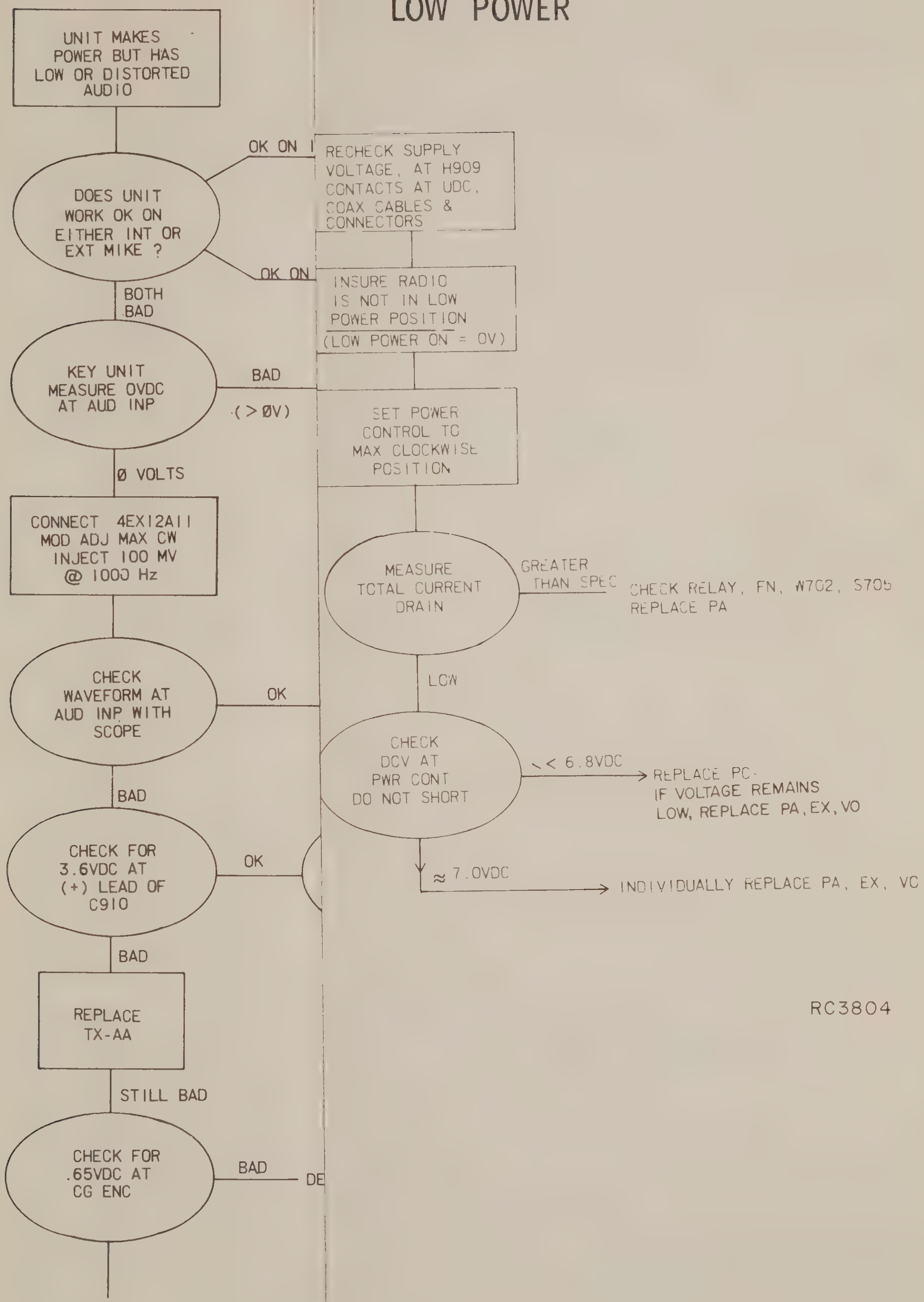
RC3797A

SECTION 8
BOTH RX & TX MALFUNCTION


RECHECK 5.4V ±.1VDC AT J701-7
BAD
SECTION 1.5
OK
BOTH TX POWER & RX SENSITIVITY LOW ?
YES
CHECK TX-FN, W702, S705, RELAY
RECHECK BATTERY VOLTAGE MEASURE >7.3VDC AT H909
<7.3VDC
SECTION 1.5
OK
CLEAN CONTACTS AT UDC J701
STILL BAD
GO TO SECTIONS 6 & 10

RC3803A

SECTION 10
LOW POWER

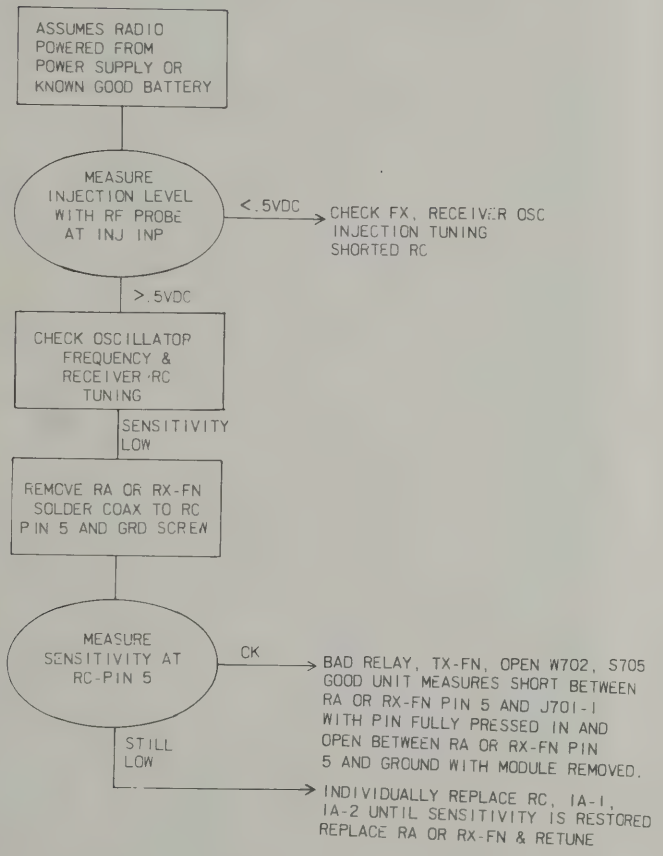

UNIT MAKES POWER BUT HAS LOW OR DISTORTED AUDIO
DOES UNIT WORK OK ON EITHER INT OR EXT MIKE ?
OK ON I
OK ON
BOTH BAD
KEY UNIT MEASURE OVDC AT AUD INP
BAD
(> 0V)
0 VOLTS
CONNECT 4EX12A11 MOD ADJ MAX CW INJECT 100 MV @ 1000 Hz
CHECK WAVEFORM AT AUD INP WITH SCOPE
OK
BAD
CHECK FOR 3.6VDC AT (+) LEAD OF C910
OK
BAD
REPLACE TX-AA
STILL BAD
CHECK FOR .65VDC AT CG ENC
BAD
DE
RECHECK SUPPLY VOLTAGE, AT H909 CONTACTS AT UDC, COAX CABLES & CONNECTORS
INSURE RADIO IS NOT IN LOW POWER POSITION (LOW POWER ON = 0V)
SET POWER CONTROL TO MAX CLOCKWISE POSITION
MEASURE TOTAL CURRENT DRAIN
GREATER THAN SPEC
CHECK RELAY, FN, W702, S705 REPLACE PA
LOW
CHECK DCV AT PWR CONT DO NOT SHORT
< 6.8VDC
REPLACE PC- IF VOLTAGE REMAINS LOW, REPLACE PA, EX, VO
≈ 7.0VDC
INDIVIDUALLY REPLACE PA, EX, VO

RC3804

TROUBLESHOOTING PROCEDURE

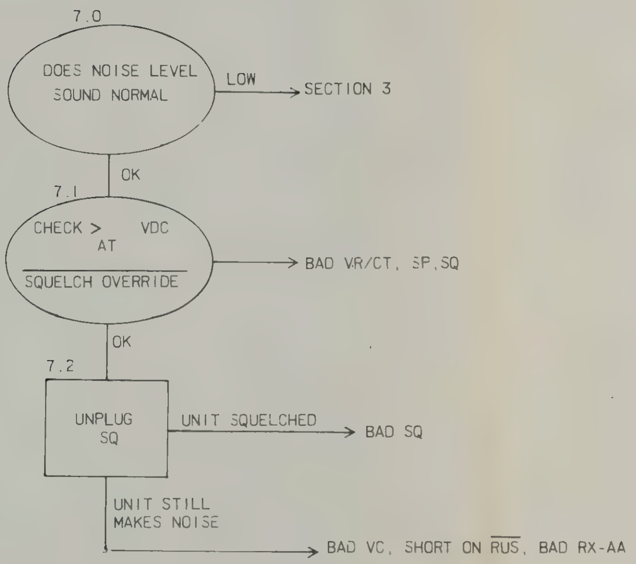
Sheet 6

SECTION 6
LOW OR NO RECEIVER SENSITIVITY


ASSUMES RADIO POWERED FROM POWER SUPPLY OR KNOWN GOOD BATTERY
MEASURE INJECTION LEVEL WITH RF PROBE AT INJ INP
<.5VDC
CHECK FX, RECEIVER OSC INJECTION TUNING SHORTED RC
>.5VDC
CHECK OSCILLATOR FREQUENCY & RECEIVER RC TUNING
SENSITIVITY LOW
REMOVE RA OR RX-FN SOLDER COAX TO RC PIN 5 AND GRD SCREW
MEASURE SENSITIVITY AT RC-PIN 5
OK
BAD RELAY, TX-FN, OPEN W702, S705 GOOD UNIT MEASURES SHORT BETWEEN RA OR RX-FN PIN 5 AND J701-1 WITH PIN FULLY PRESSED IN AND OPEN BETWEEN RA OR RX-FN PIN 5 AND GROUND WITH MODULE REMOVED.
STILL LOW
INDIVIDUALLY REPLACE RC, 1A-1, 1A-2 UNTIL SENSITIVITY IS RESTORED REPLACE RA OR RX-FN & RETUNE

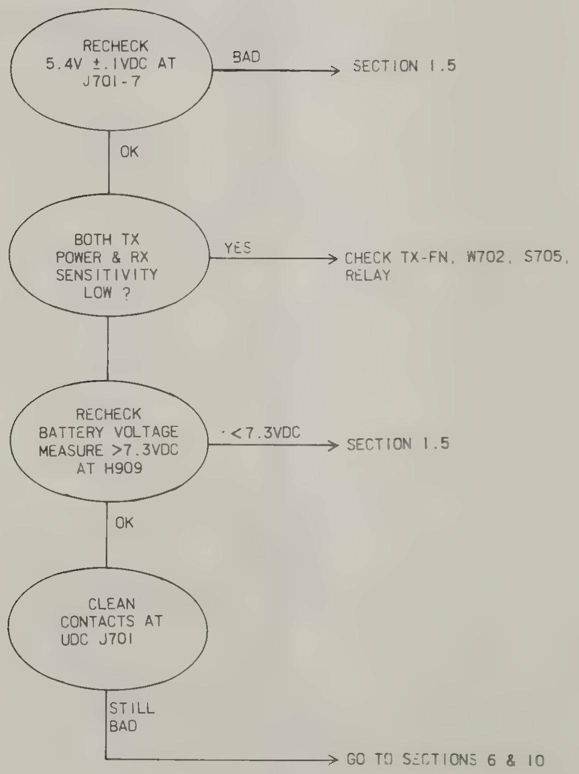
RC3798

SECTION 7
UNIT DOES NOT SQUELCH


7.0
DOES NOISE LEVEL SOUND NORMAL
LOW
SECTION 3
OK
7.1
CHECK > VDC AT SQUELCH OVERRIDE
BAD VR/CT, SP,SQ
OK
7.2
UNPLUG SQ
UNIT SQUELCHED
BAD SQ
UNIT STILL MAKES NOISE
BAD VC, SHORT ON $\overline{\text{RUS}}$, BAD RX-AA

RC3800

SECTION 8
BOTH RX & TX MALFUNCTION

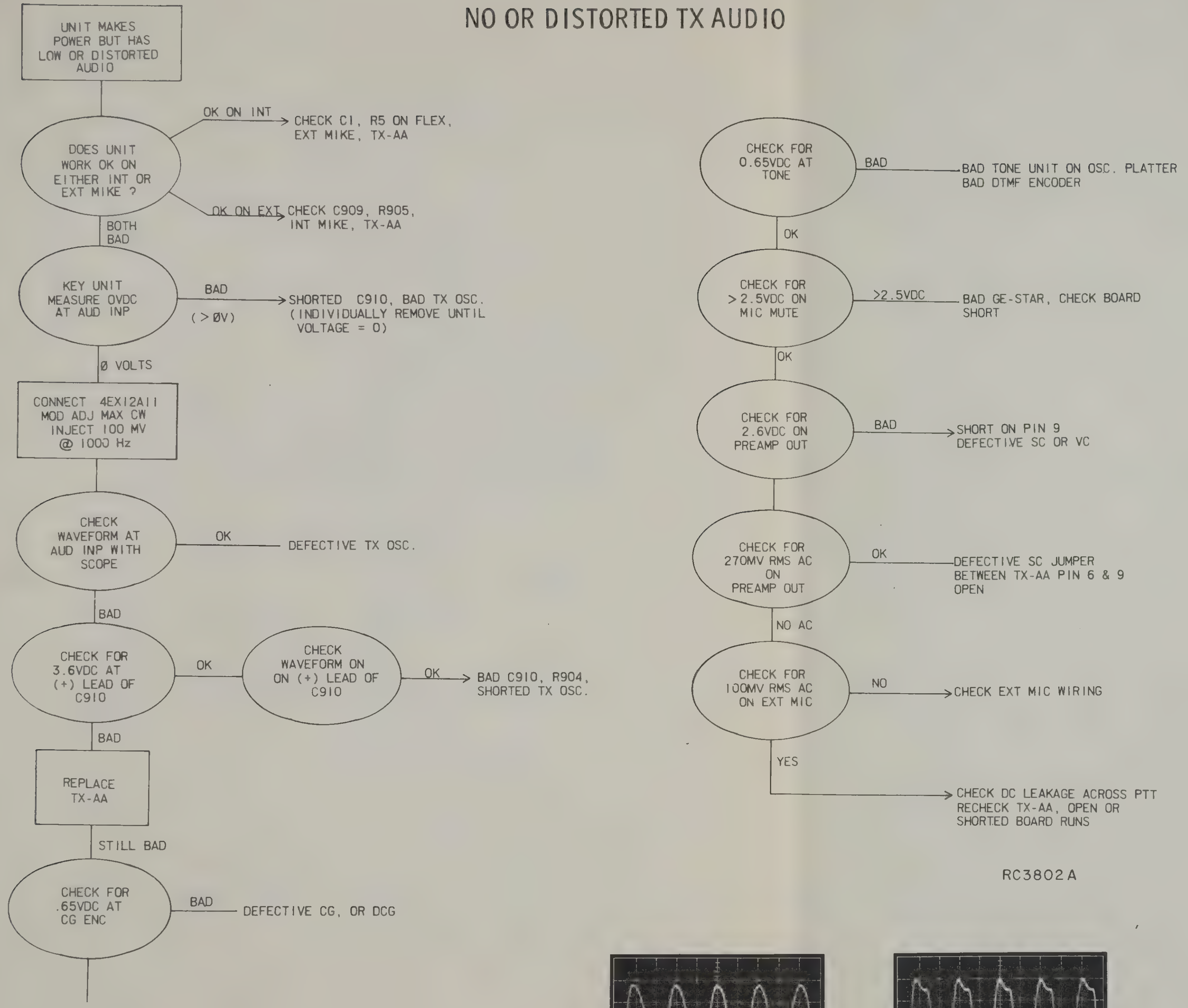

RECHECK 5.4V ±.1VDC AT J701-7
BAD
SECTION 1.5
OK
BOTH TX POWER & RX SENSITIVITY LOW ?
YES
CHECK TX-FN, W702, S705, RELAY
RECHECK BATTERY VOLTAGE MEASURE >7.3VDC AT H909
<7.3VDC
SECTION 1.5
OK
CLEAN CONTACTS AT UDC J701
STILL BAD
GO TO SECTIONS 6 & 10

RC3803A

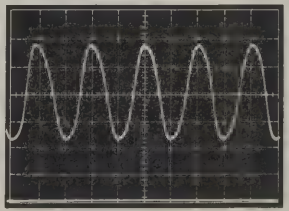
TROUBLESHOOTING PROCEDURE

Sheet 5

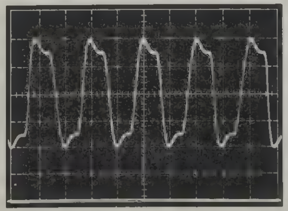
SECTION 9
NO OR DISTORTED TX AUDIO


UNIT MAKES POWER BUT HAS LOW OR DISTORTED AUDIO
DOES UNIT WORK OK ON EITHER INT OR EXT MIKE ?
OK ON INT
CHECK C1, R5 ON FLEX, EXT MIKE, TX-AA
OK ON EXT
CHECK C909, R905, INT MIKE, TX-AA
BOTH BAD
KEY UNIT MEASURE 0VDC AT AUD INP
BAD
(> 0V)
SHORTED C910, BAD TX OSC. (INDIVIDUALLY REMOVE UNTIL VOLTAGE = 0)
0 VOLTS
CONNECT 4EX12A11 MOD ADJ MAX CW INJECT 100 MV @ 1000 Hz
CHECK WAVEFORM AT AUD INP WITH SCOPE
OK
DEFECTIVE TX OSC.
BAD
CHECK FOR 3.6VDC AT (+) LEAD OF C910
OK
CHECK WAVEFORM ON ON (+) LEAD OF C910
OK
BAD C910, R904, SHORTED TX OSC.
BAD
REPLACE TX-AA
STILL BAD
CHECK FOR .65VDC AT CG ENC
BAD
DEFECTIVE CG, OR DCG
CHECK FOR 0.65VDC AT TONE
BAD
BAD TONE UNIT ON OSC. PLATTER BAD DTMF ENCODER
OK
CHECK FOR >2.5VDC ON MIC MUTE
>2.5VDC
BAD GE-STAR, CHECK BOARD SHORT
OK
CHECK FOR 2.6VDC ON PREAMP OUT
BAD
SHORT ON PIN 9 DEFECTIVE SC OR VC
CHECK FOR 270MV RMS AC ON PREAMP OUT
OK
DEFECTIVE SC JUMPER BETWEEN TX-AA PIN 6 & 9 OPEN
NO AC
CHECK FOR 100MV RMS AC ON EXT MIC
NO
CHECK EXT MIC WIRING
YES
CHECK DC LEAKAGE ACROSS PTT RECHECK TX-AA, OPEN OR SHORTED BOARD RUNS

RC3802A

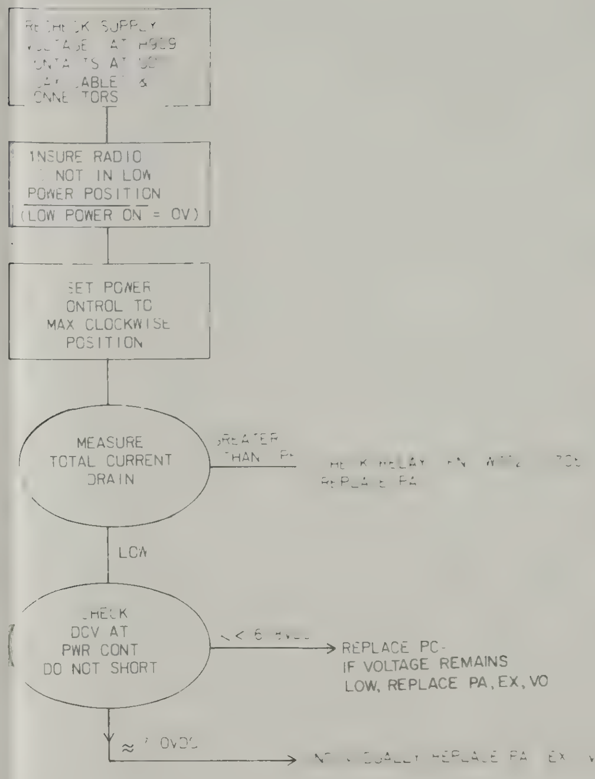


WAVEFORM WITH COMPRESSOR



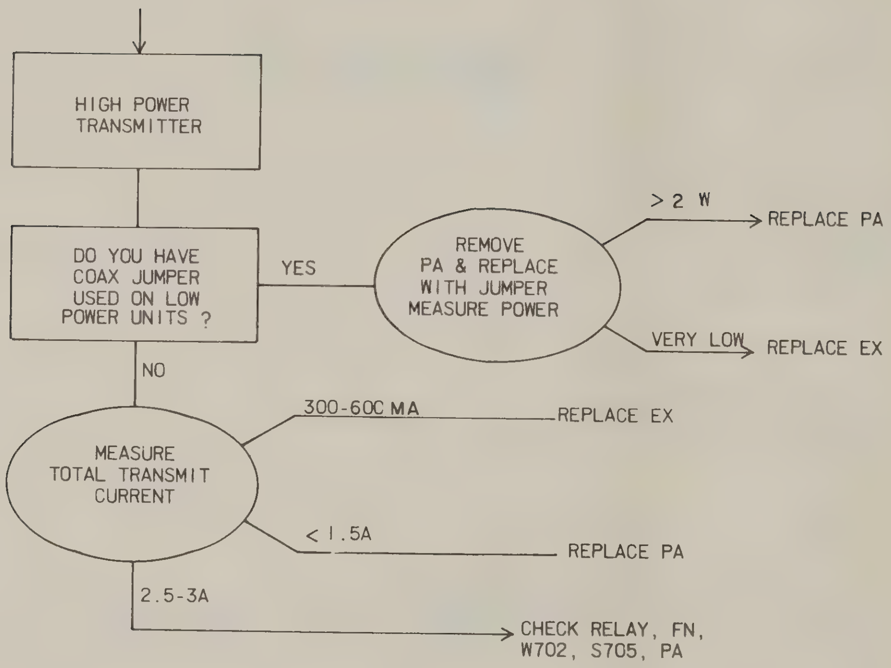
WAVEFORM WITHOUT COMPRESSOR

SECTION 10
LOW POWER


RECHECK SUPPLY VOLTAGE AT H909 CONTACTS AT [illegible] CABLES & CONNECTORS
INSURE RADIO NOT IN LOW POWER POSITION (LOW POWER ON = 0V)
SET POWER CONTROL TO MAX CLOCKWISE POSITION
MEASURE TOTAL CURRENT DRAIN
GREATER THAN
REPLACE PA
LOW
CHECK DCV AT PWR CONT DO NOT SHORT
< 6
REPLACE PC- IF VOLTAGE REMAINS LOW, REPLACE PA, EX, VO
≈ 0VDC
REPLACE PA EX VO

RC3804

SECTION II
NO TRANSMIT POWER

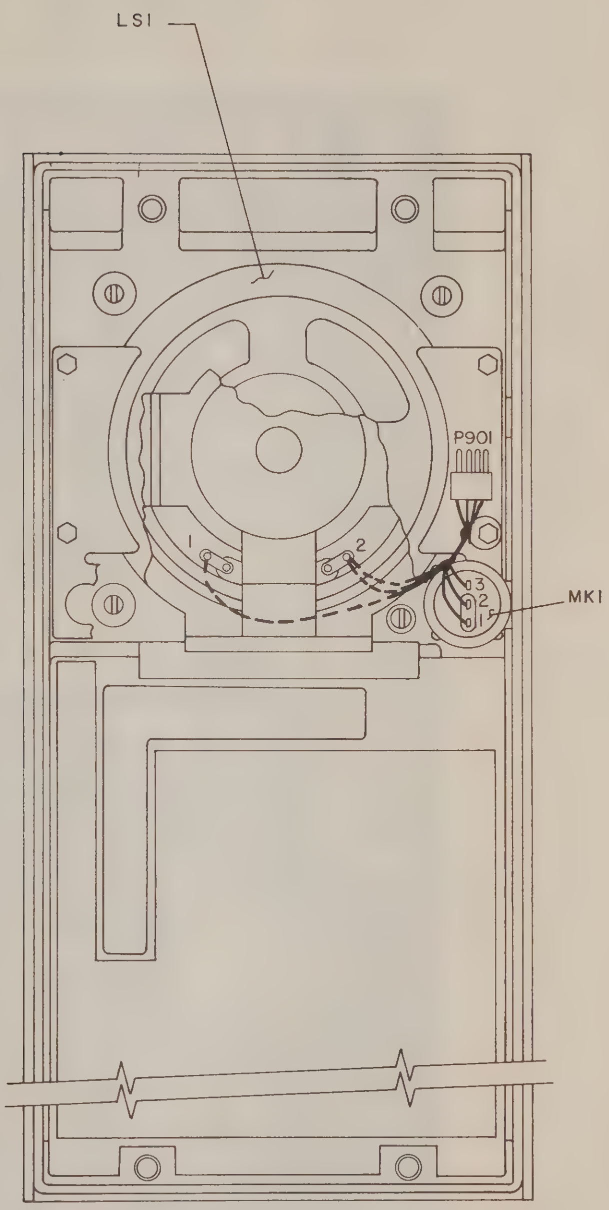

HIGH POWER TRANSMITTER
DO YOU HAVE COAX JUMPER USED ON LOW POWER UNITS ?
YES
REMOVE PA & REPLACE WITH JUMPER MEASURE POWER
> 2 W
REPLACE PA
VERY LOW
REPLACE EX
NO
MEASURE TOTAL TRANSMIT CURRENT
300-600 MA
REPLACE EX
< 1.5A
REPLACE PA
2.5-3A
CHECK RELAY, FN, W702, S705, PA

RC3801A

LEX

S1
H12 H11
H14 H13
H16 H15

FRONT COVER


LS1
P901
MK1
1
2
3
2
1

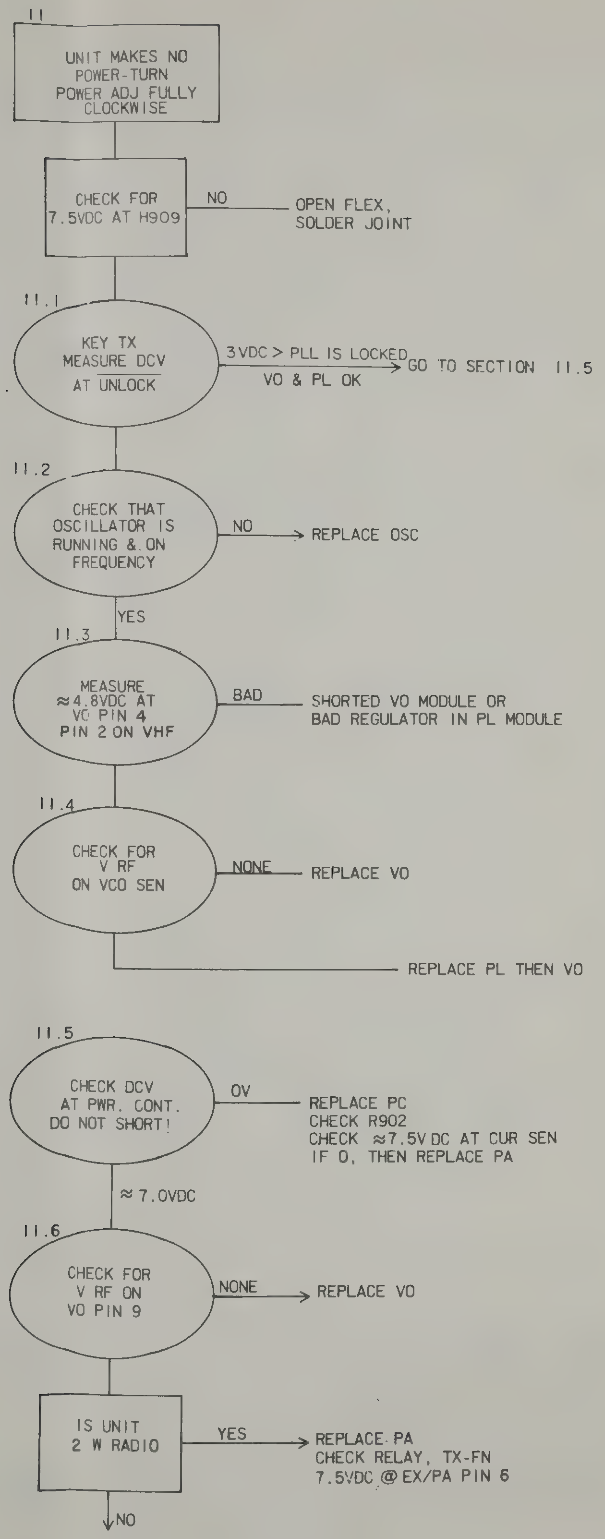
CONNECTION CHART		
FROM	TO	WIRE
P901	LS1 - 1	W
	MK1 - 2	O
	MK1 - 1	R
	LS1 - 2	BK
LS1 - 2	MK1 - 3	T28 - BK

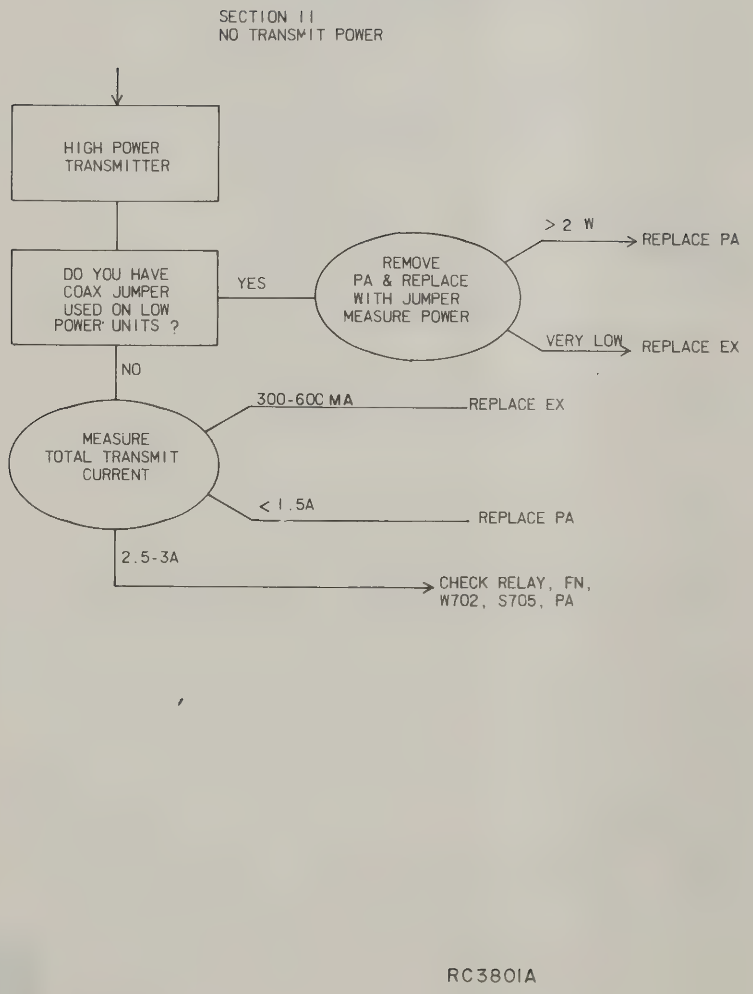
(19C330384, Rev. 0)

OUTLINE DIAGRAM

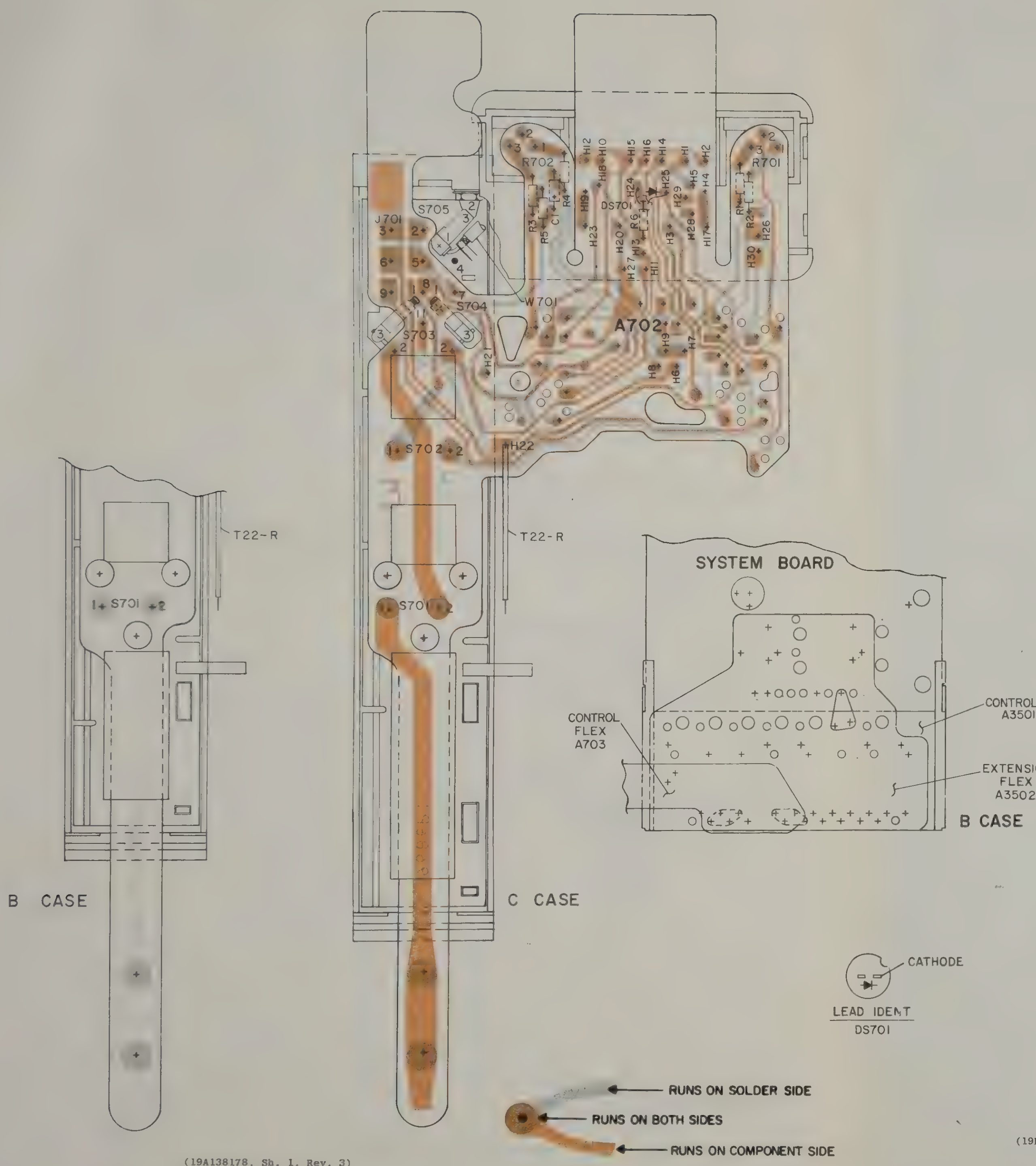
CONTROL ASSEMBLY FRONT
(Sheet 1)

SECTION 11
NO TRANSMIT POWER


11
UNIT MAKES NO POWER-TURN POWER ADJ FULLY CLOCKWISE
CHECK FOR 7.5VDC AT H909
NO
OPEN FLEX, SOLDER JOINT
11.1
KEY TX MEASURE DCV AT UNLOCK
3VDC > PLL IS LOCKED
VO & PL OK
GO TO SECTION 11.5
11.2
CHECK THAT OSCILLATOR IS RUNNING & ON FREQUENCY
NO
REPLACE OSC
YES
11.3
MEASURE ≈4.8VDC AT VO PIN 4 PIN 2 ON VHF
BAD
SHORTED VO MODULE OR BAD REGULATOR IN PL MODULE
11.4
CHECK FOR V RF ON VCO SEN
NONE
REPLACE VO
REPLACE PL THEN VO
11.5
CHECK DCV AT PWR. CONT. DO NOT SHORT!
OV
REPLACE PC
CHECK R902
CHECK ≈7.5V DC AT CUR SEN
IF 0, THEN REPLACE PA
≈7.0VDC
11.6
CHECK FOR V RF ON VO PIN 9
NONE
REPLACE VO
IS UNIT 2 W RADIO
YES
REPLACE PA
CHECK RELAY, TX-FN
7.5VDC @ EX/PA PIN 6
NO


SECTION 11
NO TRANSMIT POWER
HIGH POWER TRANSMITTER
DO YOU HAVE COAX JUMPER USED ON LOW POWER UNITS ?
YES
REMOVE PA & REPLACE WITH JUMPER MEASURE POWER
> 2 W
REPLACE PA
VERY LOW
REPLACE EX
NO
MEASURE TOTAL TRANSMIT CURRENT
300-600 MA
REPLACE EX
< 1.5A
REPLACE PA
2.5-3A
CHECK RELAY, FN, W702, S705, PA
RC3801A

CONTROL ASSEMBLY


A702
R702
R701
S705
S704
S703
J701
W701
DS701
S702
H22
T22-R
S701
B CASE
C CASE

(19A138178, Sh. 1, Rev. 3)
(19A138178, Sh. 2, Rev. 3)

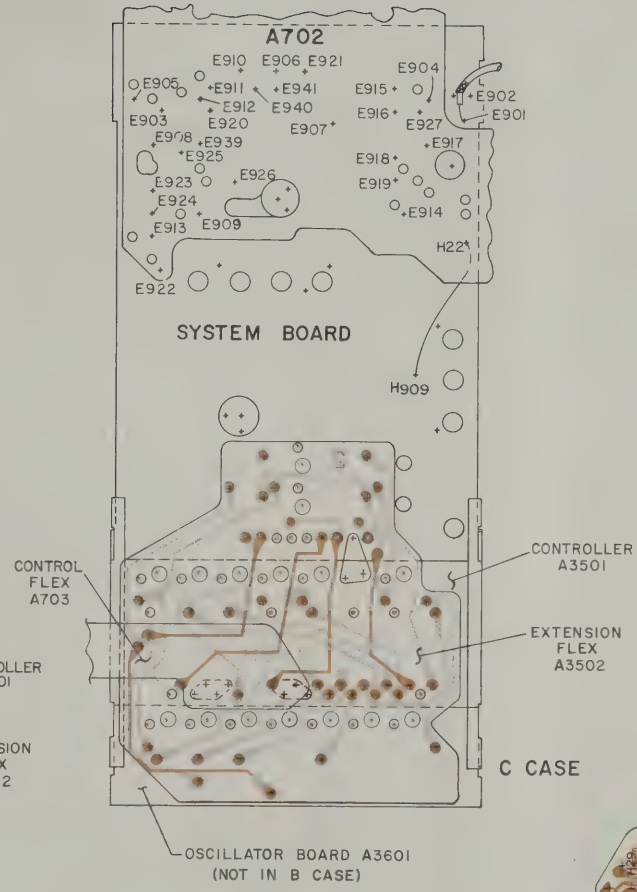
RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE

SYSTEM BOARD
CONTROL FLEX A703
CONTROLLER A3501
EXTENSION FLEX A3502
B CASE

CATHODE

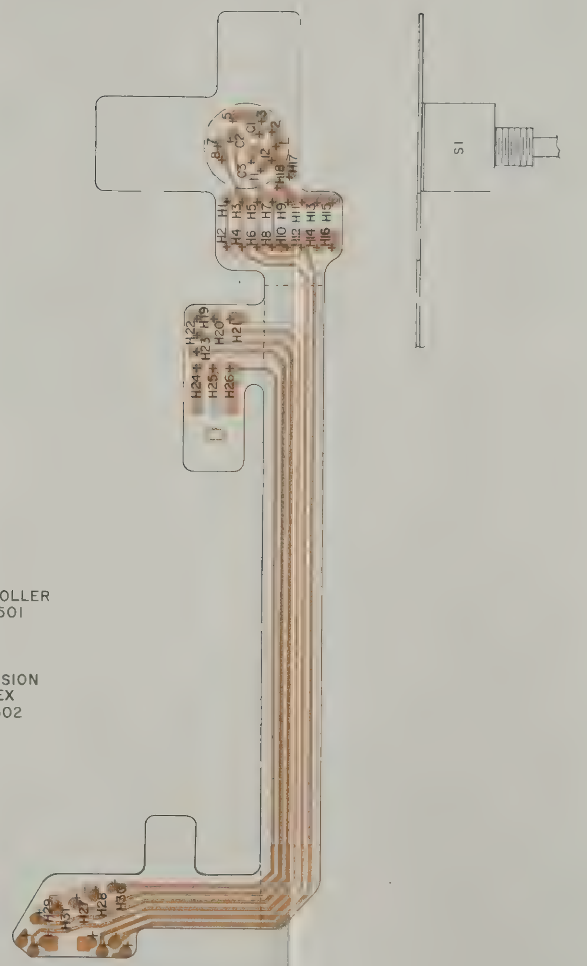
LEAD IDENT
DS701

(19D430397, Rev. 3)


A702
E910
E906
E921
E904
E905
E911
E941
E915
E902
E912
E940
E916
E901
E903
E920
E927
E908
E939
E907
E917
E925
E918
E926
E923
E919
E924
E914
E913
E909
H22
E922
SYSTEM BOARD
H909
CONTROL FLEX A703
CONTROLLER A3501
EXTENSION FLEX A3502
C CASE
OSCILLATOR BOARD A3601 (NOT IN B CASE)

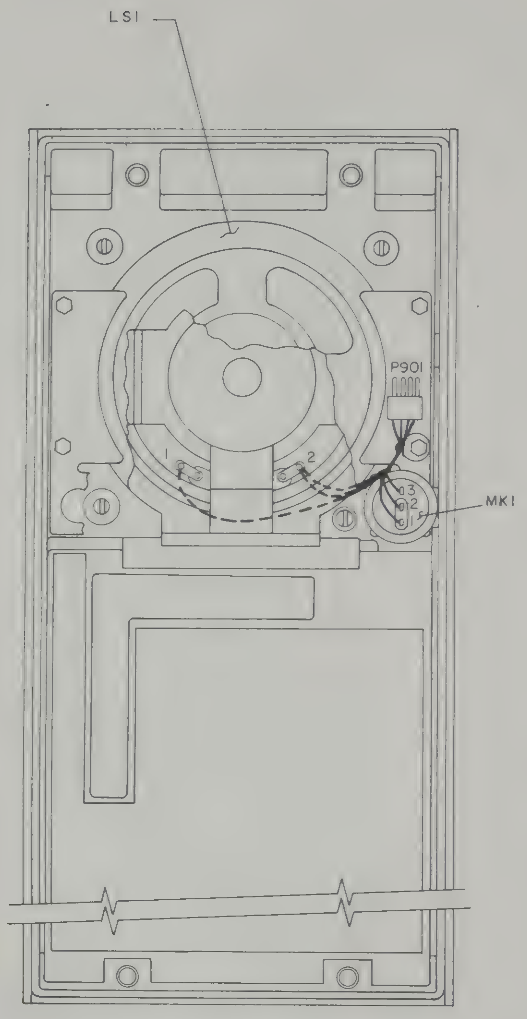
(19A138199, Sh. 1, Rev. 2)
(19A138199, Sh. 2, Rev. 3)

CONTROL FLEX
A703



(19A137416, Sh. 1, Rev. 0)
(19A137416, Sh. 2, Rev. 0)

FRONT COVER

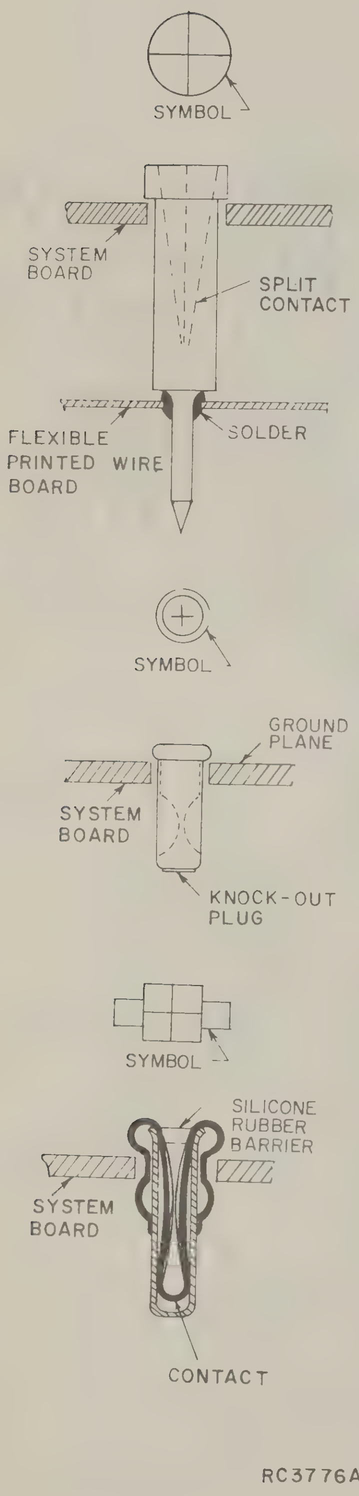

LS1
P901
MK1

CONNECTION CHART		
FROM	TO	WIRE
P901	LS1-1	W
	MK1-2	O
	MK1-1	R
	LS1-2	BK
LS1-2	MK1-3	T28-BK

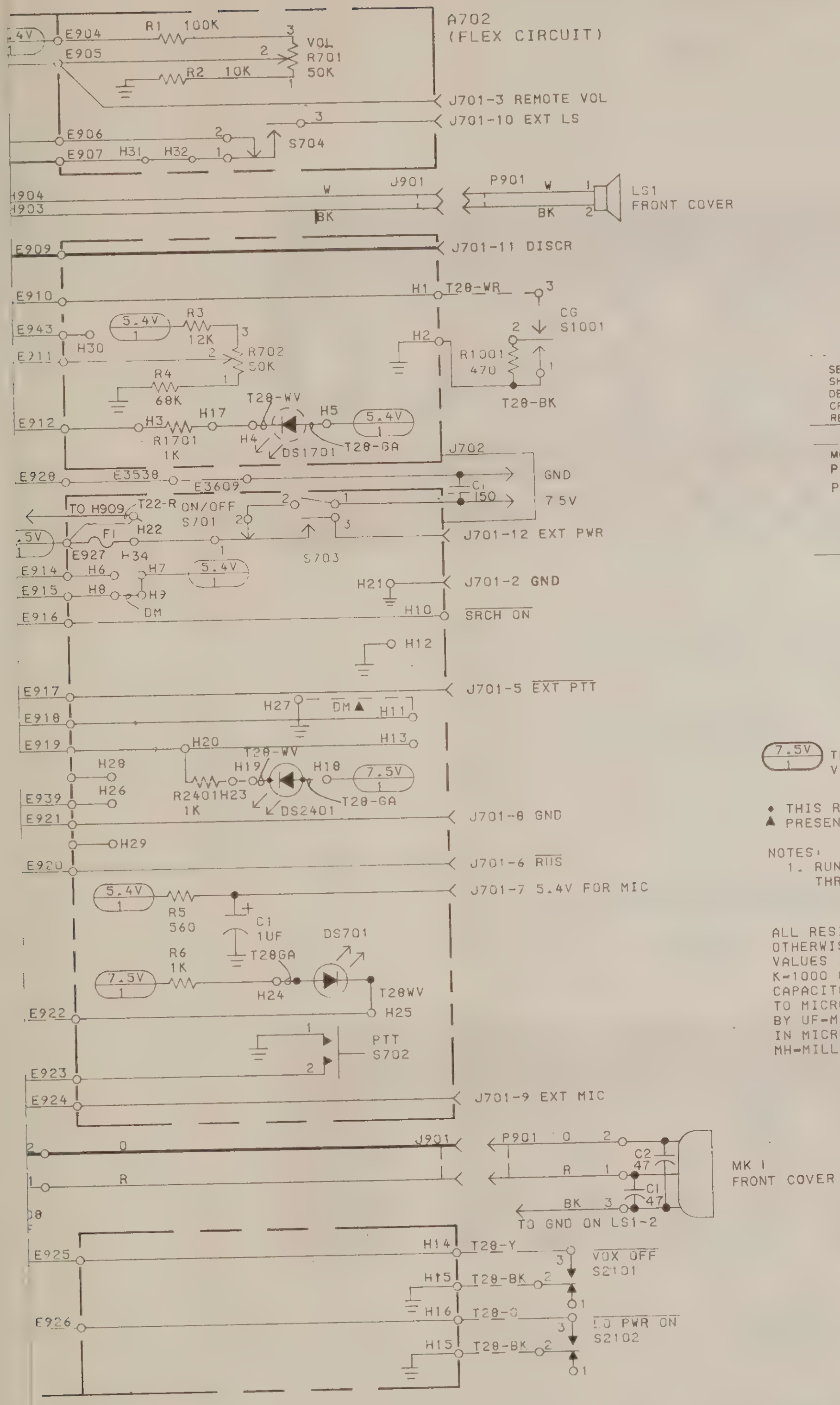
(19C330384, Rev. 0)

OUTLINE DIAGRAM

CONTROL ASSEMBLY FRONT
(Sheet 1)


SYMBOL
SYSTEM BOARD
SPLIT CONTACT
FLEXIBLE PRINTED WIRE BOARD
SOLDER
SYMBOL
GROUND PLANE
SYSTEM BOARD
KNOCK-OUT PLUG
SYMBOL
SILICONE RUBBER BARRIER
SYSTEM BOARD
CONTACT
RC3776A

CONTACT IDENTIFICATION


A702
(FLEX CIRCUIT)
E904
E905
R1 100K
VOL R701 50K
R2 10K
J701-3 REMOTE VOL
J701-10 EXT LS
E906
E907
H31
H32
S704
H904
H903
W
BK
J901
P901
LS1 FRONT COVER
E909
J701-11 DISCR
E910
H1
T28-WR
CG S1001
E943
5.4V
R3 12K
E711
H30
R702 50K
H2
R1001 470
R4 68K
T28-BK
E912
H3
H17
T28-WV
H5
R1701 1K
H4
DS1701
T28-GA
J702
E928
E3538
E3609
C1 150
GND
7.5V
TO H909
T22-R
ON/OFF S701
J701-12 EXT PWR
5V
F1
H22
E927
H34
S703
E914
H6
H7
E915
H8
H9
DM
H21
J701-2 GND
E916
H10
SRCH ON
H12
E917
J701-5 EXT PTT
E918
H27
DM ▲
H11
E919
H20
H13
T28-WV
H28
H19
H18
7.5V
E939
H26
R2401
H23
1K
DS2401
T28-GA
E921
J701-8 GND
H29
E920
J701-6 RUS
J701-7 5.4V FOR MIC
R5 560
C1 1UF
DS701
T28GA
R6 1K
H24
T28WV
H25
E922
PTT S702
E923
E924
J701-9 EXT MIC
O
R
P901
C2 47
C1 47
MK 1 FRONT COVER
BK
TO GND ON LS1-2
E925
H14
T28-Y
VOX OFF S2101
H15
T28-BK
H16
T28-O
E926
LO PWR ON S2102

SEE APPLICABLE PRODUCTION CHANGE SHEETS IN INSTRUCTION BOOK SECTION DEALING WITH THIS UNIT, FOR DESCRIPTION OF CHANGES UNDER EACH REVISION LETTER.

THIS ELEM DIAG APPLIES TO

MODEL NO	REV LETTER
PL19C328418G2	A
PL19C328418G3	A

7.5V 1 THE HEAVY LINE INDICATES THE VOLTAGE SOURCE ON THE SYSTEM BOARD.

◆ THIS RUN CUT WITH SC OPTION
▲ PRESENT IN SINGLE FREQ UNITS ONLY

NOTES:
1. RUNS ARE CUT HERE IN A THREE (3) OR MORE FREQ UNITS.

ALL RESISTORS ARE 1/8 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF=MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH=MILLIHENRYS OR H=HENRYS.

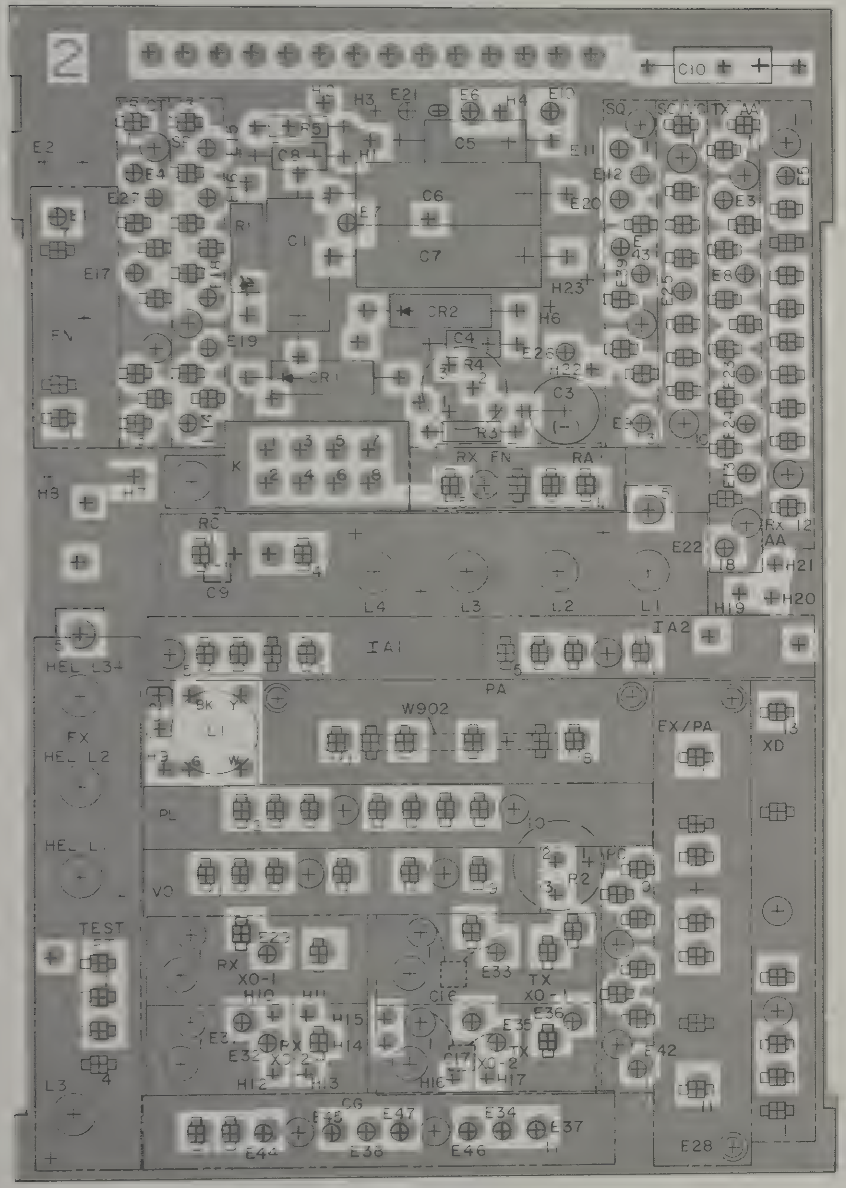
SCHEMATIC DIAGRAM

138—174 MHz MPR TWO-WAY FM RADIO

Issue 2

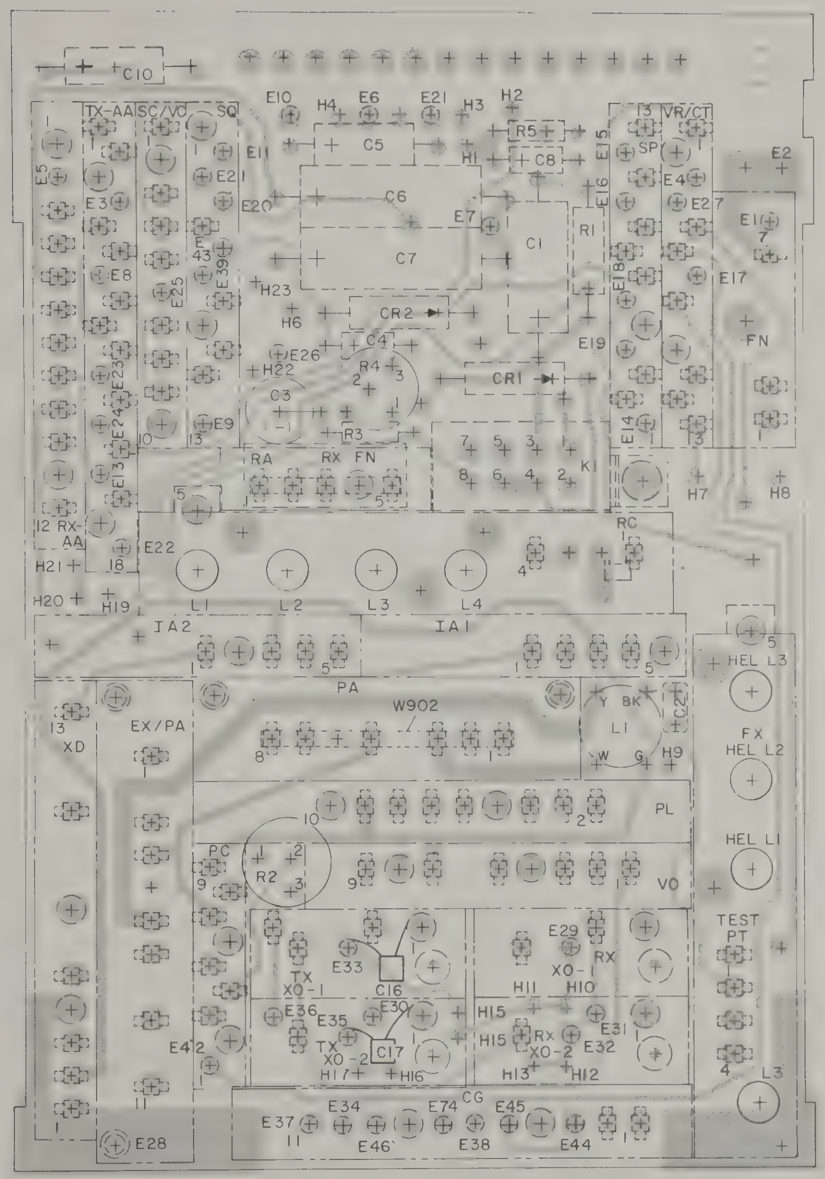
SYSTEM BOARD

PARTIAL REFERENCE DESIGNATIONS ARE SHOWN ALL DESIGNATIONS ARE 900 SERIES, EXAMPLE C1-C901


2
C10
C5
C6
C7
C8
C1
C3
C4
CR1
CR2
R1
R3
R4
E17
FN
H3
H23
RX FN
RA
RC
C9
L4
L3
L2
L1
E22
H21
H20
H19
IA1
IA2
PA
W902
EX/PA
XD
HEL L3
FX HEL L2
HEL L1
L1
PL
PC
R2
VO
TEST
RX XO-1
TX XO-1
TX XO-2
H10
H11
H12
H15
H16
H17
C16
C17
CG
E34
E37
E38
E44
E46
E28

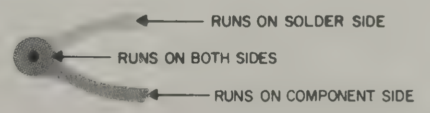
FRONT SIDE

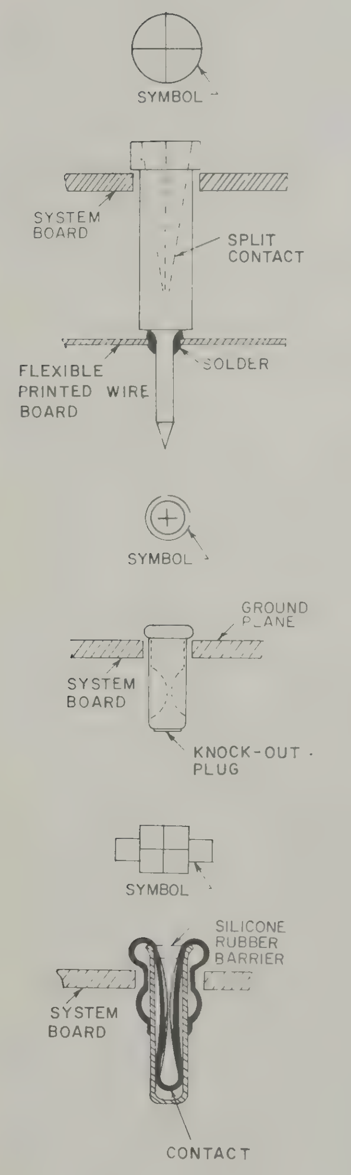
(19B232313, First Layer, Rev. 2)


C10
TX-AA
SC/VO
SQ
E10
H4
E6
E21
H3
H2
R5
C8
VR/CT
SP
C5
C6
C7
C1
R1
E7
E2
E17
FN
CR2
CR1
C4
C3
R3
R4
H22
H23
H6
E26
E19
K1
RA
RX FN
H7
H8
RC
12 RX-AA
H21
H20
H19
E22
L1
L2
L3
L4
IA2
IA1
PA
W902
13 XD
EX/PA
L1
BK
W
G
H9
HEL L3
FX HEL L2
HEL L1
PL
PC
R2
VO
TEST PT
E33
TX XO-1
E36
E35
TX XO-2
H17
H16
C16
C17
E30
E29
RX XO-1
H11
H10
H15
RX XO-2
H13
H12
E32
E31
E42
E34
E37
E74
CG
E45
E46
E38
E44
E28
L3

BACK SIDE

(19B232313, Fourth Layer, Rev. 2)


RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE


SYMBOL
SYSTEM BOARD
SPLIT CONTACT
FLEXIBLE PRINTED WIRE BOARD
SOLDER
SYMBOL
GROUND PLANE
SYSTEM BOARD
KNOCK-OUT PLUG
SYMBOL
SILICONE RUBBER BARRIER
SYSTEM BOARD
CONTACT

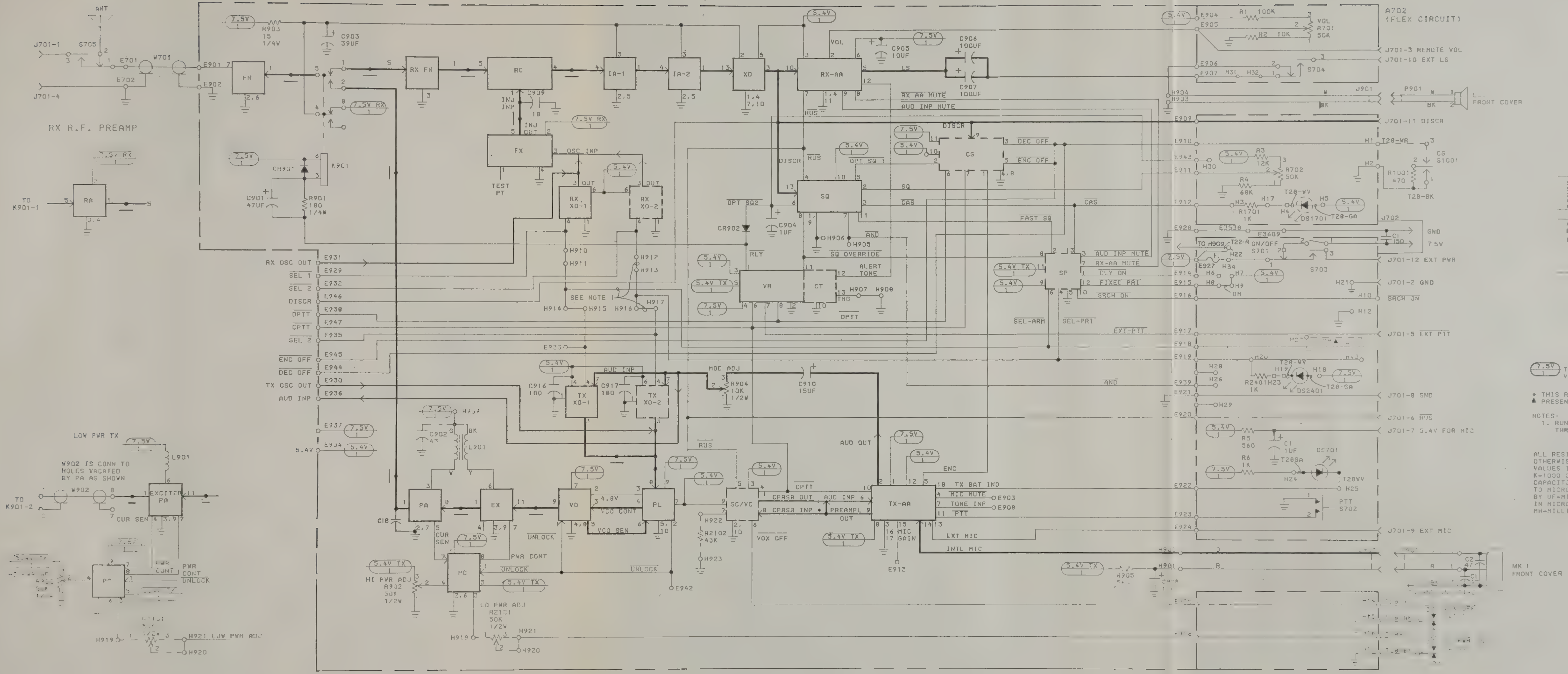
RC3776A

CONTACT IDENTIFICATION

OUTLINE DIAGRAM

(19D429555, Rev. 7)

SYSTEM BOARD
(Sheet 2)


ANT
J701-1
S705
E701
W701
E702
J701-4
E901
E902
FN
RX R.F. PREAMP
RA
TO K901-1
R903 15 1/4W
C903 39UF
K901
CR901
C901 47UF
R901 180 1/4W
RX FN
RC
C909 18
INJ INP
INJ OUT
FX
TEST PT
OSC INP
RX XO-1
RX XO-2
IA-1
IA-2
XD
RX-AA
VOL
C905 10UF
C906 100UF
C907 100UF
LS
RX AA MUTE
AUD INP MUTE
RUS
DISCR
CG
DEC OFF
ENC OFF
OPT SQ 1
OPT SQ2
SQ
CAS
CR902
C904 1UF
H906
H905
AND
SQ OVERRIDE
RLY
VR
CT
ALERT TONE
H907
H908
DPTT
FAST SQ
SP
AUD INP MUTE
RX-AA MUTE
CLY ON
FIXED PRI
SRCH ON
SEL-ARM
SEL-PRI
EXT-PTT
RX OSC OUT
SEL 1
SEL 2
DISCR
DPTT
CPTT
SEL 2
ENC OFF
DEC OFF
TX OSC OUT
AUD INP
5.4V
E931
E929
E932
E946
E938
E947
E935
E945
E944
E930
E936
E937
E934
H910
H911
H912
H913
SEE NOTE 1
H914
H915
H916
H917
E933
C916 180
TX XO-1
C917 180
TX XO-2
AUD INP
MOD ADJ
R904 10K 1/2W
C910 15UF
AUD OUT
RUS
LOW PWR TX
L901
W902 IS CONN TO HOLES VACATED BY PA AS SHOWN
TO K901-2
W902
EXCITER PA
CUR SEN
C902 43
L901
H909
PA
EX
VO
PL
C18
VCO CONT
VCO SEN
UNLOCK
CUR SEN
PC
PWR CONT
HI PWR ADJ R902 50K 1/2W
LO PWR ADJ H2101 50K 1/2W
H919
H921
H920
H921 LOW PWR ADJ
E942
SC/VC
CPRSR OUT
CPRSR INP
AUD INP
PREAMPL OUT
H922
R2102 43K
H923
VOX OFF
CPTT
ENC
TX-AA
TX BAT IND
MIC MUTE
TONE INP
PTT
MIC GAIN
EXT MIC
INTL MIC
E903
E908
E913
H905
H901
A702 (FLEX CIRCUIT)
E904
E905
R1 100K
R2 10K
VOL R701 50K
J701-3 REMOTE VOL
J701-10 EXT LS
E906
E907
H31
H32
S704
H904
H903
J901
P901
FRONT COVER
W
BK
E909
J701-11 DISCR
E910
H1
T28-VR
CG S1001
E943
H30
R3 12K
R702 50K
E911
H2
R1001 470
T28-BK
R4 68K
E912
H3
H17
T28-VV
H5
R1701 1K
H4
DS1701
T28-GA
E928
E3538
E3609
J702
GND
7.5V
TO H909
T22-R
ON/OFF S701
S703
E927
H22
H34
H6
H7
J701-12 EXT PWR
E914
H8
H9
OM
E915
J701-2 GND
H21
H10
E916
SRCH ON
H12
E917
J701-5 EXT PTT
E918
E919
H28
H26
R2401
H23
1K
T28-VV
H19
H18
DS2401
T28-GA
E939
E921
H29
J701-8 GND
E920
J701-6 RUS
R5 560
C1 1UF
T28GA
J701-7 5.4V FOR MIC
R6 1K
H24
DS701
T28VV
H25
E922
E923
PTT S702
E924
J701-9 EXT MIC
MK 1 FRONT COVER
C2 47
C1
H905
7.5V
5.4V
5.4V TX
7.5V RX

SEE APPLICABLE PRODUCTION CHANGE SHEETS IN INSTRUCTION BOOK SECTION DEALING WITH THIS UNIT, FOR DESCRIPTION OF CHANGES UNDER EACH REVISION LETTER

THIS ELEM DIAG APPLIES TO	
MODEL NO	REV LETTER
PL19C328418G2	A
PL19C328418G3	A

(7.5V / 1) THE HEAVY LINE INDICATES THE VOLTAGE SOURCE ON THE SYSTEM BOARD.

◆ THIS RUN CUT WITH SC OPTION
▲ PRESENT IN SINGLE FREQ UNITS ONLY

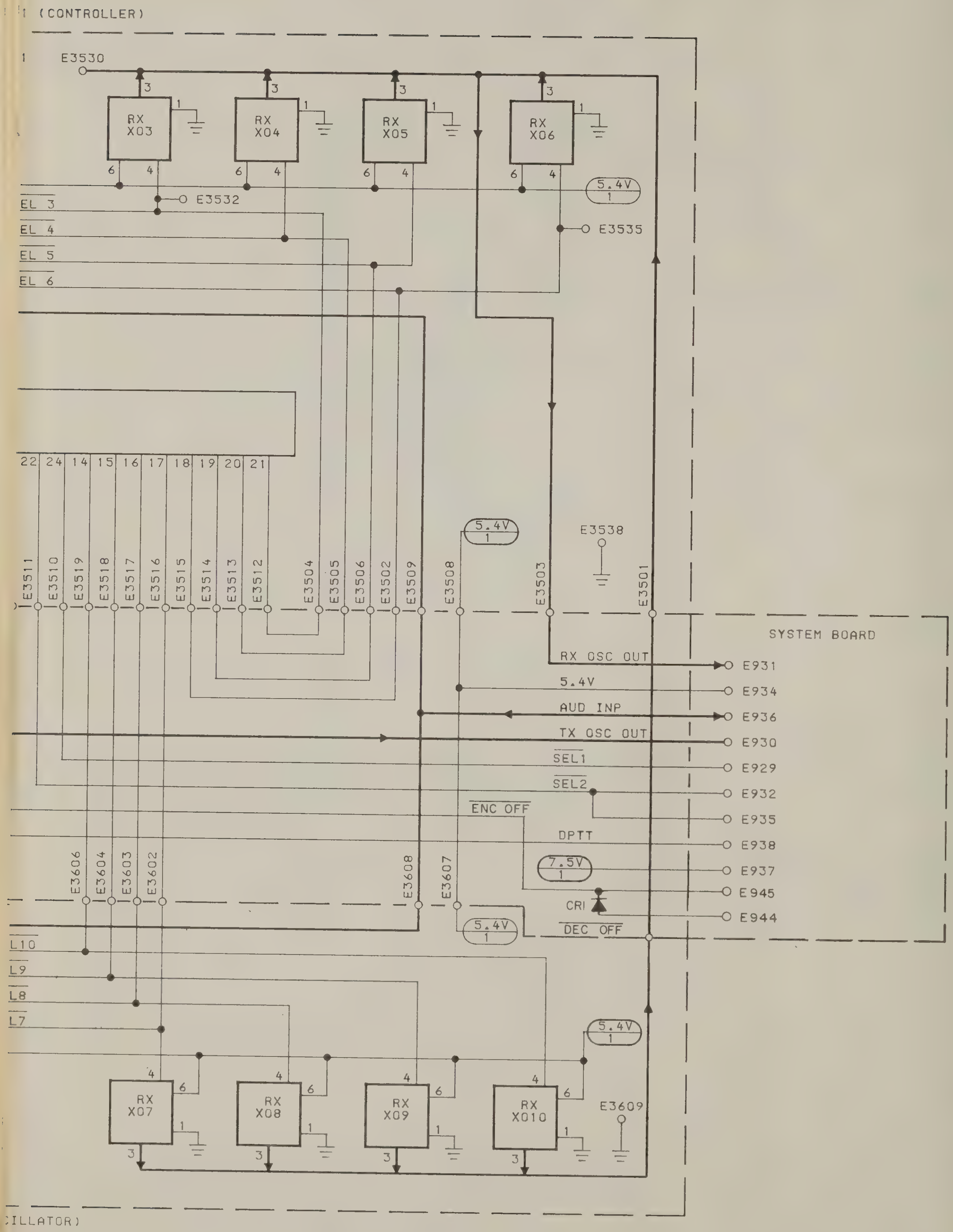
NOTES:
1. RUNS ARE CUT HERE IN A THREE (3) OR MORE FREQ UNITS.

ALL RESISTORS ARE 1/8 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF=MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH=MILLIHENRYS OR H=HENRYS.

(19R622354, Rev. 11)

SCHEMATIC DIAGRAM

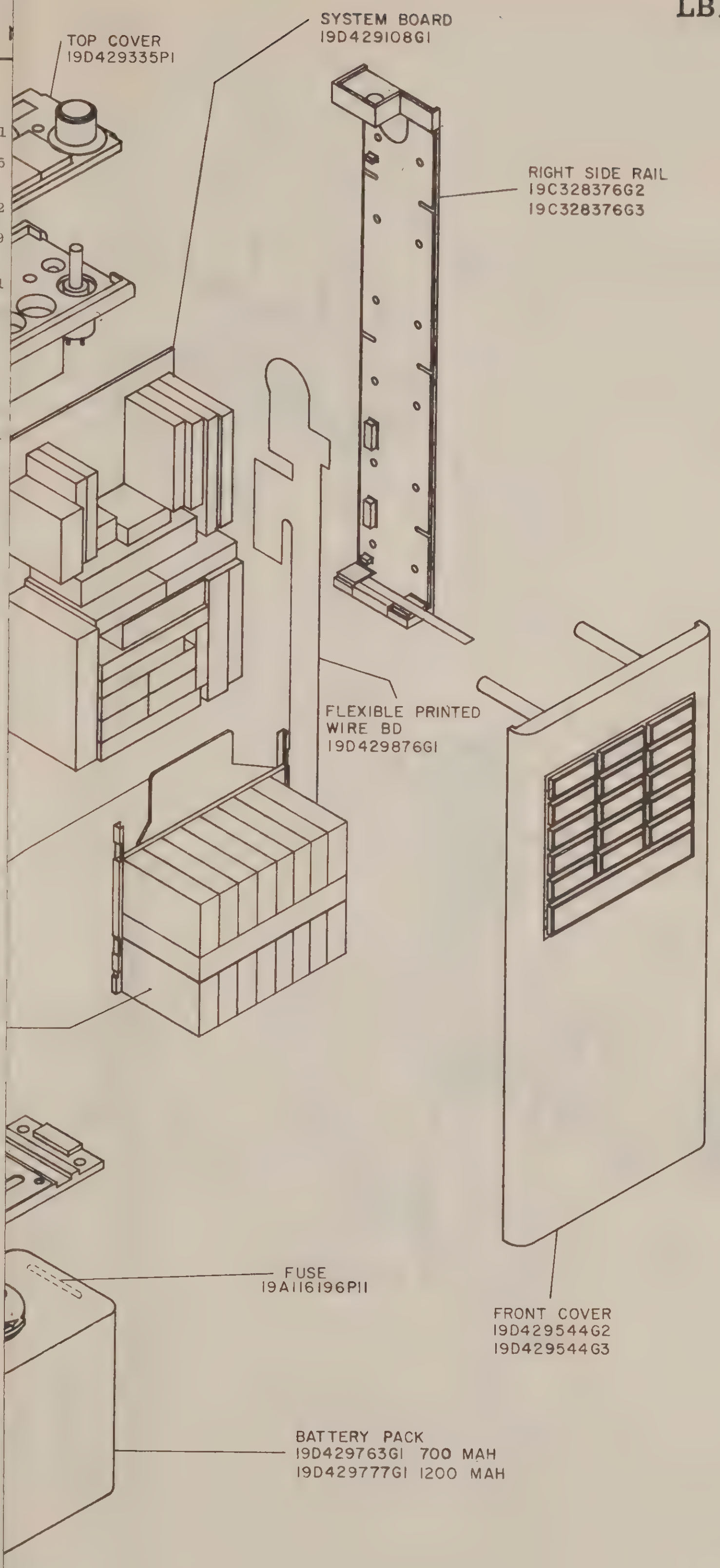
138—174 MHz MPR TWO-WAY FM RADIO


(CONTROLLER)
E3530
RX X03
RX X04
RX X05
RX X06
5.4V 1
E3532
E3535
EL 3
EL 4
EL 5
EL 6
22 24 14 15 16 17 18 19 20 21
E3511 E3510 E3519 E3518 E3517 E3516 E3515 E3514 E3513 E3512 E3504 E3505 E3506 E3502 E3509 E3508 E3503 E3501
E3538
SYSTEM BOARD
RX OSC OUT
E931
5.4V
E934
AUD INP
E936
TX OSC OUT
E930
SEL1
E929
SEL2
E932
E935
ENC OFF
DPTT
E938
7.5V 1
E937
E945
CR1
E944
DEC OFF
E3606 E3604 E3603 E3602 E3608 E3607
L10
L9
L8
L7
RX X07
RX X08
RX X09
RX X010
E3609
CILLATOR)

NOTES:

1. CUT THESE RUNS WHEN SP IS USED, ASSEMBLE DIODES. EXAMPLE; H1 O—◀—O H2
2. USE HOLES H9-H16 TO PROGRAM THE PRIORITY CHANNEL WHEN SP IS USED. EXAMPLE; H9 O—▶—O H10

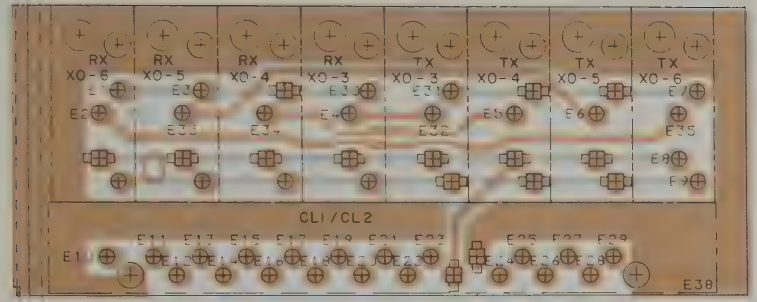
G-E PART
19B232662P1
19A115834P5
19B200525P2
19A115834P9
19B209648P1
4035306P62
19A127884G1


TOP COVER
19D429335P1
SYSTEM BOARD
19D429108G1
RIGHT SIDE RAIL
19C328376G2
19C328376G3
FLEXIBLE PRINTED
WIRE BD
19D429876G1
FUSE
19A116196P11
FRONT COVER
19D429544G2
19D429544G3
BATTERY PACK
19D429763G1 700 MAH
19D429777G1 1200 MAH
RC3857

PARTS LISTS

Sheet 1

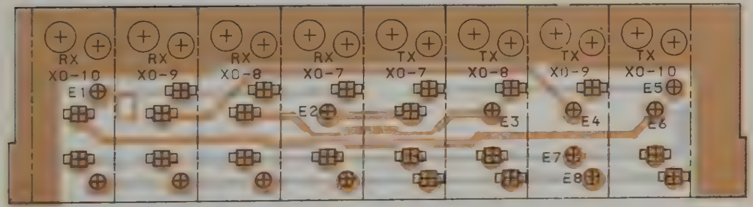
CONTROLLER BOARD
A3501


RX XO-6
RX XO-5
RX XO-4
RX XO-3
TX XO-3
TX XO-4
TX XO-5
TX XO-6
CL1/CL2
E1
E2
E3
E4
E5
E6
E7
E8
E9
E12
E14
E16
E18
E22
E24
E26
E28
E38

NOTES.
1. PARTIAL REFERENCE DESIGNATIONS SHOWN. ALL DESIGNATIONS ARE 3500 SERIES: EXAMPLE: E1- E3501.

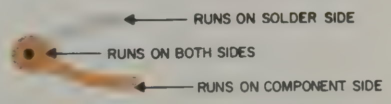
(RC-4119)
(19C328514, Rev. 2)
(19A138188, Sh. 1, Rev. 0)
(19A138188, Sh. 2, Rev. 0)

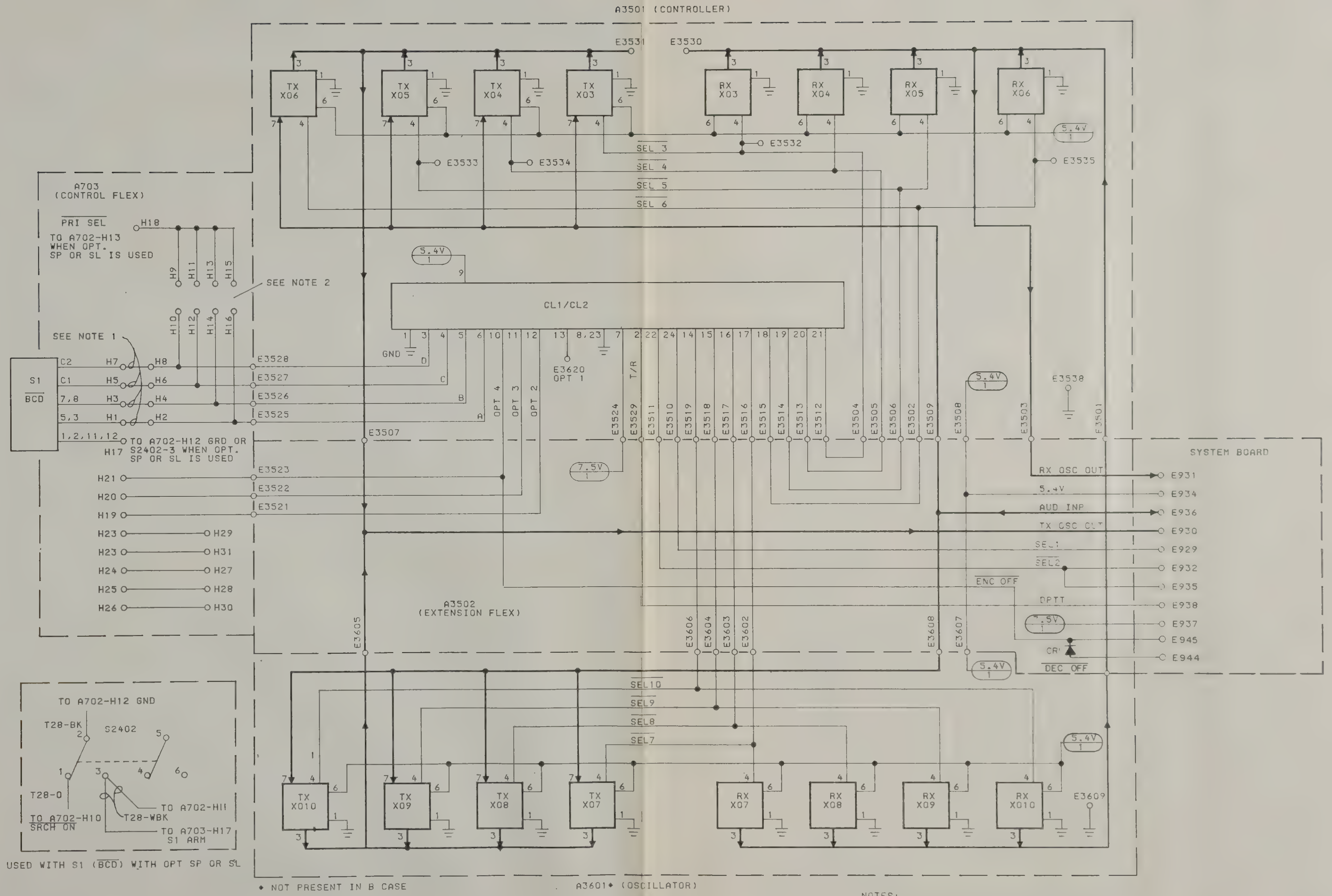
OSCILLATOR BOARD
A3601


RX XO-10
RX XO-9
RX XO-8
RX XO-7
TX XO-7
TX XO-8
TX XO-9
TX XO-10
E1
E2
E3
E4
E5
E6
E7
E8

NOTES:
1. PARTIAL REFERENCE DESIGNATIONS SHOWN. ALL DESIGNATIONS ARE 3600 SERIES; EXAMPLE; E1-E3601.

(19C328171, Rev. 1)
(19A138184, Sh. 1. Rev. 0)
(19A138184, Sh. 2, Rev. 0)


RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE


A3501 (CONTROLLER)
E3531
E3530
TX X06
TX X05
TX X04
TX X03
RX X03
RX X04
RX X05
RX X06
E3533
E3534
E3532
E3535
SEL 3
SEL 4
SEL 5
SEL 6
5.4V
A703
(CONTROL FLEX)
PRI SEL
H18
TO A702-H13 WHEN OPT. SP OR SL IS USED
H9
H11
H13
H15
SEE NOTE 2
H10
H12
H14
H16
SEE NOTE 1
S1
BCD
C2
C1
7,8
5,3
1,2,11,12
H7
H5
H3
H1
H8
H6
H4
H2
H17
TO A702-H12 GRD OR S2402-3 WHEN OPT. SP OR SL IS USED
E3528
E3527
E3526
E3525
E3523
E3522
E3521
H21
H20
H19
H23
H23
H24
H25
H26
H29
H31
H27
H28
H30
CL1/CL2
GND
E3620 OPT 1
OPT 4
OPT 3
OPT 2
T/R
E3507
E3524
E3529
E3511
E3510
E3519
E3518
E3517
E3516
E3515
E3514
E3513
E3512
E3504
E3505
E3506
E3502
E3509
E3508
E3503
E3501
E3538
7.5V
A3502
(EXTENSION FLEX)
SYSTEM BOARD
RX OSC OUT
5.4V
AUD INP
TX OSC OUT
SEL1
SEL2
ENC OFF
DPTT
7.5V
CR1
DEC OFF
E931
E934
E936
E930
E929
E932
E935
E938
E937
E945
E944
E3605
E3606
E3604
E3603
E3602
E3608
E3607
SEL10
SEL9
SEL8
SEL7
TX X010
TX X09
TX X08
TX X07
RX X07
RX X08
RX X09
RX X010
E3609
TO A702-H12 GND
T28-BK
S2402
T28-O
TO A702-H10 SRCH ON
T28-WBK
TO A702-H11
TO A703-H17 S1 ARM
USED WITH S1 (BCD) WITH OPT SP OR SL
◆ NOT PRESENT IN B CASE
A3601◆ (OSCILLATOR)

NOTES:
1. CUT THESE RUNS WHEN SP IS USED. ASSEMBLE DIODES. EXAMPLE; H1 ○—◀|—○ H2
2. USE HOLES H9-H16 TO PROGRAM THE PRIORITY CHANNEL WHEN SP IS USED. EXAMPLE; H9 ○—◀|—○ H10

(19D429731, Rev. 2)

OUTLINE & SCHEMATIC DIAGRAM

MULTI-FREQUENCY KIT
19A137836G1 & G2

PARTS LIST

MPR MODULE LIST
P01B & P01C COMBINATIONS
19A142620
(138-174 MHz)
ISSUE 2

SYMBOL	GE PART NO.	DESCRIPTION
CG	19D429618G1	Channel Guard.
CL1	19D430085G1	Simple Controller.
CL2	19D430091G1	Delux Controller.
CT	19D429505G2	Carrier Controlled Timer (Includes Voltage Regulator).
EA	19D429471G1	(138-150.8 MHz) Exciter for 3.8 to 6.4 watt transmit.
	19D429471G2	(150.8-174 MHz) Exciter for 3.8 to 6.4 watt transmit.
EX/PA	19D429471G3	(138-150.8 MHz) Exciter and Power Amplifier for 1.6 to 3.8 watt transmit.
	19D429471G4	(150.8-174 MHz) Exciter and Power Amplifier for 1.6 to 3.8 Watt transmit.
FN	19D429438G1	Low Pass Filter.
FA	19D429429G1	(138-162 MHz) Injection Frequency Multiplier.
	19D429429G2	(162-174 MHz) Injection Frequency Multiplier.
IA-1	19D429542G1	IF preamplifier.
IA-2	19D429482G1	IF Amplifier.
PA	19D429414G1	(138-150.8 MHz) RF Power Amplifier.
	19D429414G2	(150.8-174 MHz) RF Power Amplifier.
PC	19D429538G1	Power Control.
PL	19D429540G1	(138-150.8 MHz) Phase Lock Loop.
	19D429540G2	(150.8-174 MHz) Phase Lock Loop.
RA	19D429533G1	Receive RF preamplifier.
RC	19D429508G1	(138-150.8 MHz) Receive Front End.
	19D429508G2	(150.8-162 MHz) Receive Front End.
	19D429508G3	(162-174 MHz) Receive Front End.
RX-AA	19D429420G1	Receive Audio Amplifier.
RX-FN	19B233143G1	Passive Filter.
RX-XO	19A137645G1	Receive Oscillator.
S	19D429525G3	Search Lock.
SC	19D429546G1	Speech Compressor.
SC/VC	19D429546G3	Speech Compressor & Voice Control.
SP	19D429525G1	Priority Search Lock Monitor.
SQ	19D429426G1	Squelch.
TX-AA	19D429486G2	Transmit Audio Processor.
TX-XO	19A137646G1	Transmit Oscillator.
VC	19D429546G2	Voice Control.
VO	19D429548G1	(138-150.8 MHz) Voltage Controlled Oscillator.
	19D429548G2	(150.8-174 MHz) Voltage Controlled Oscillator.
VR	19D429505G1	Voltage Regulator. (Does not include CT).
XD	19D429422G1	Receiver Discriminator.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

PARTS LIST

SYSTEM BOARD
19D429108G1
ISSUE 3

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - - CAPACITORS - - - - - - - - - -
C901	5491674P42	Tantalum: 47 µf ±20%, 6 VDCW; sim to Sprague Type 162D.
C902	19A700221P51	Ceramic: 43 pf ±5%, 100 VDCW; temp coef -80 PPM.
C903	5491674P30	Tantalum: 39 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C904	5491674P1	Tantalum: 1.0 µf +40-20%, 10 VDCW; sim to Sprague Type 162D.
C905	5491674P37	Tantalum: 10 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C906 and C907	19B200240P19	Tantalum: 100 µf ±20%, 6 VDCW.
C908	5491674P1	Tantalum: 1.0 µf +40-20%, 10 VDCW; sim to Sprague Type 162D.
C909	19A700007P25	Ceramic: 18 pf ±5%, 50 VDCW; temp coef 0 ±30 M/°C.
C910	5491674P34	Tantalum: 15 µf ±20%, 6 VDCW; sim to Sprague Type 162D.
C916 and C917	19A700229P73	Ceramic: 180 pf ±10%, 100 VDCW; temp coef -3300 PPM/°C.
		- - - - - - - - - DIODES AND RECTIFIERS - - - - - -
CR901 and CR902	5494922P1	Silicon; sim to Type 1N456.
		- - - - - - - - - - - TERMINALS - - - - - - - - - -
E1	19A134591P1	Contact, electrical: sim to Augat LSG-1AG14-14.
E3 thru E27	19A134591P1	Contact, electrical: sim to Augat LSG-1AG14-14.
E28	4033513P23	Contact, electrical: sim to Bead Chain R62-11A.
E29 thru E39	19A134591P1	Contact, electrical: sim to Augat LSG-1AG14-14.
E42	19A134591P1	Contact, electrical: sim to Augat LSG-1AG14-14.
		- - - - - - - - JACKS AND RECEPTACLES - - - - - - - -
J901	19A134584P1	Plug: 3 amp max rating, wire No. 28 AWG stranded.
		- - - - - - - - - - - - RELAYS - - - - - - - - - -
K901	19B209666P1	Sensitive, hermetic sealed: 90 ohms ±10%, 5.75 to 9.0 VDC nominal, 2 form C contact; sim to C.P. Clare MF1401G03.
		- - - - - - - - - - - INDUCTORS - - - - - - - - - -
L901	19B232664G1	Coil.
		- - - - - - - - - - RESISTORS - - - - - - - - - - -
R901	19A700106P45	Composition: 180 ohms ±5%, 1/4 w.
R902	19A134512P8	Variable, cermet: 50K ohms ±10%, 0.5 w; sim to A-B A2A503.
R903	19A134564P1	Metal film: 15 ohms ±5%; sim to Corning Glass Style FP 1/4.
R904	19A134512P7	Variable, cermet: 10K ohms ±10%, 0.5 w; sim to A-B A2A103.
R905	3R151P561J	Composition: 560 ohms ±5%, 1/8 w.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

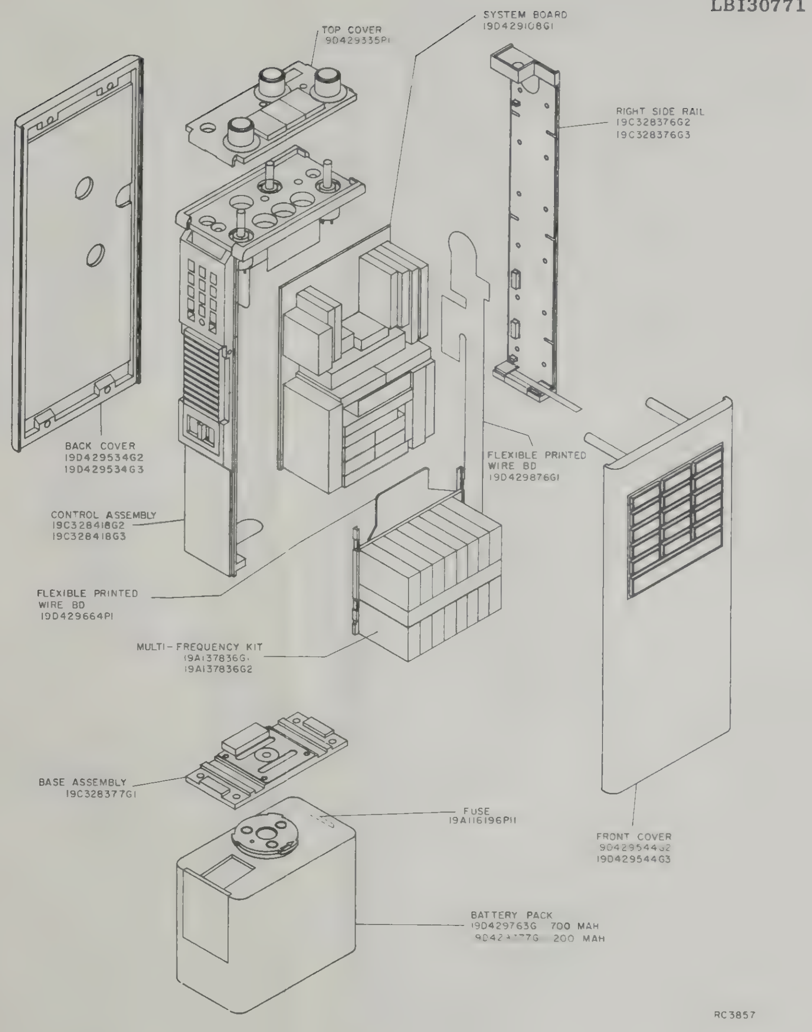
SYMBOL	G-E PART NO	DESCRIPTION
		- - - - - - - - - - MISCELLANEOUS - - - - - - - - - -
	19B232662P1	Support. (K901).
	19A115834P5	Contact, electrical: sim to AMP 3-331272-5. (Used with K901).
	19B200525P2	Rivet, tubular. (Secures K901 support).
	19A115834P9	Contact, electrical: sim to AMP 2-32070-4. (Quantity 30).
	19B209648P1	Contact, electrical. (Quantity 120).
	4035306P62	Washer, fiber. (Located on pins 1, 4, 5 & 8 of K901).
		ASSOCIATED PARTS
F901	19A127884G1	Fuse Kit.

PARTS LIST

MULTI-FREQUENCY KIT
19A137836G1 B CASE
19A137836G2 C CASE
ISSUE 3

SYMBOL	GE PART NO.	DESCRIPTION
A703	19D429876G1	Flexible Printed Wire Board.
A3501	19C328512G1	Controller Board.
A3502	19C331224G1	Flexible Printed Wire Board.
A3601	19C328172G1	Oscillator Board. (C CASE ONLY).
		- - - - - - - - - - - - MISCELLANEOUS - - - - - - - -
	19C328193P1	Dial, scaled.
	19C328108P3	Knob, set screw.
	19A127319P2	Nut: 1/4-28.
	19A143453P1	Set screw, self locking: 3-48 x 1/8.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

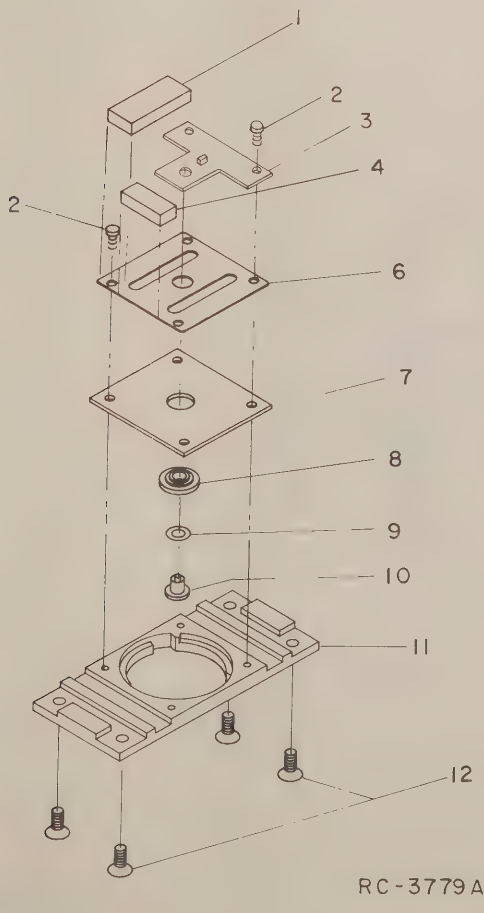


PARTS LIST

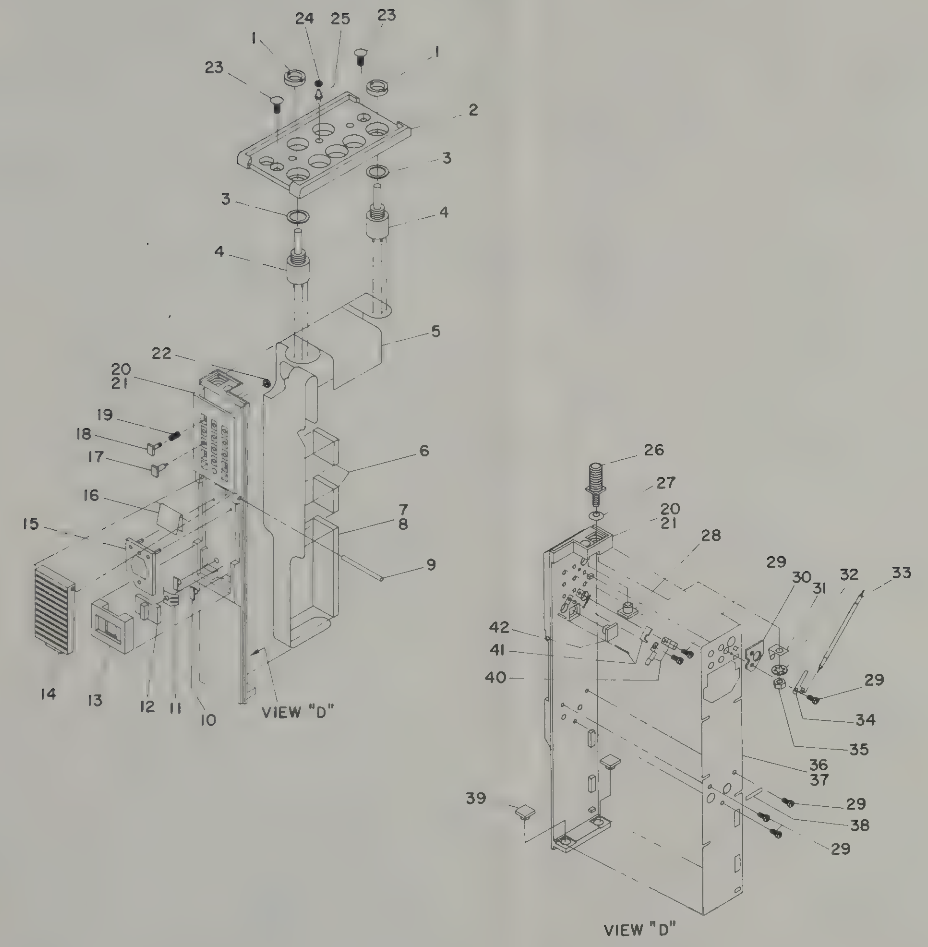
BASE ASSEMBLY
19C328377G1
(SEE RC3779)
ISSUE 3

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - - CAPACITORS - - - - - - - - -
C1	19A700007P65	Ceramic: 150 pf ±5%, 50 VDCW; temp coef 0 ±30 Parts/M/° C.
		MECHANICAL PARTS
1	19B232682P5	Pad.
2	19A134793P1804	Tap screw, thd. forming (Metric).
3	19C330619P1	Printed board.
4	19B232682P11	Pad.
6	19B232497P1	Spring.
7	19B237706P1	Pad.
8	19A137490P1	Insulator.
9	4035306P70	Washer, non-metallic.
10	19A137531P1	Contact.
11	19D429248P1	Base.
12	19A134586P2506	Machine screw: 2.5 with 0.45 thd. pitch, 6MM long- Not included with base assembly).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES



RC-3779A



RC-3853

PARTS LIST

CONTROL ASSEMBLY
19C328418G2 B CASE
19C328418G3 C CASE
ISSUE 3

SYMBOL	GE PART NO.	DESCRIPTION
A702		B & C SYSTEM FLEX BOARD 19D429687G1
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	5491674P1	Tantalum: 1.0 µf +40-20%, 10 VDCW; sim to Sprague Type 162D.
		- - - - - - - - - - RESISTORS - - - - - - - - -
R1	3R151P104J	Composition: 100K ohms ±5%, 1/8 w.
R2	3R151P103J	Composition: 10K ohms ±5%, 1/8 w.
R3	3R151P123J	Composition: 12K ohms ±5%, 1/8 w.
R4	3R151P683J	Composition: 68K ohms ±5%, 1/8 w.
R5	3R151P561J	Composition: 560 ohms ±5%, 1/8 w.
R6	3R151P102J	Composition: 1K ohms ±5%, 1/8 w.
		- - - - - - - - - - - CABLES - - - - - - - - - -
W701	19A137417G1	Cable wire: approx 2 inches long.
		SIDE RAIL 19D429564G2 (B CASE) 19D429564G3 (C CASE)
		- - - - - - - - JACKS AND RECEPTACLES - - - - - -
J701		(See items 17-19 & 22 on RC3853).
		- - - - - - - - - - SWITCHES - - - - - - - - - -
S701		(See items 10-13 on RC3853).
S702		(See items 9, 14-16 on RC3853).
S703		(See items 18, 19, 22, 29, 40 & 41 on RC3853).
S704		(See items 18, 19, 22, 29, 40 & 41 on RC3853).
S705		(See items 18, 19, 22, 30, 31 & 34 on RC3853).
		TOP PLATE 19C328388G2
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R701 and R702	19A134528P3	Variable, cermet: 50K ohms ±10%, 1 w. (Part of Mechanical Parts RC3853, item 4).
		MECHANICAL PARTS (SEE RC3853)
1	19A127319P1	Nut: 1/4-32. (Used with R701 & R702- Volume & Squelch).
2	19D429340P1	Top plate.
3	4037064P14	Washer, non-metallic. (Used with R701 & R702- Volume & Squelch, & dummy plug).
4	19A134528P3	Resistor, variable: 50K ohms ±10%, 1 w. (R701 & R702).
5	19D429686P1	Printed Board. (A702).
6	19B232682P8	Pad.
7	19B232682P14	Pad. (B CASE).
8	19B232682P15	Pad. (C CASE).
9	19A134585P1	Pin, spring. (Part of S702).
10	19B232651P1	Contact. (Part of S701).
11	19B232560P1	Spring. (Part of S701).
12	19A137826G1	Slide. (Part of S701).
13	19C328373P1	Plate. (Part of S701).
14	19C328176P1	Button. (Part of S702).
15	19B209643P2	Switch, push: 200 milliohms res max; sim to Bowmar KB3256-1D. (Part of S702).
16	19A137414P1	Spring. (Part of S702).
17	19B232413P1	Contact. (J701-2 thru J701-9, J701-11).
18	19B232416P1	Contact. (Part of S703-S705).
19	4035235P13	Spring. (Part of S703-S705).
20	19D429241P2	Left side rail. (B CASE).
21	19D429241P3	Left side rail. (C CASE).
22	19A137413P1	Seal. (Part of S703-S705).
23	19A134586P2506E	Machine screw: 2.5- 0.45 x 6MM. (Secures top plate & Base assembly to side rails).
24	19A134582P1	washer, non-metallic. (Not Used).
25	19A143255G1	Diode, optoelectronic: red. (DS702).
26	19A137411P1	Antenna stud.
27	19A115983P14	Packing.
28	19A137410P1	Bushing. (Secures top plate to left side rail).
29	19A134588P1	Drive screw. (Part of S703 & S704).
30	19B232672P1	Insulator. (Part of S705).
31	19B232671P1	Contact. (Part of S705).
32	19A134657P2	Lockwasher, internal tooth: Metric, M2.2.
33	19A137417G1	Cable. (W701).
34	19B232670P1	Contact. (Part of S705).
35	19A134590P4	Hex nut, Metric: 2.5 x 0.45.
36	19C328385P2	Shield. (B CASE).
37	19C328385P3	Shield. (C CASE).
38	4039064P34	Strap.
39	19A137410P1	Bushing. (Secures base assembly to side rails).
40	19B232417P1	Contact. (Part of S703 & S704).
41	19B232414P1	Contact. (Part of S703 & S704).
42	19B232415P1	Bushing.
43	19B232416P2	Contact. (Part of S703 & S704).
44	19A134588P4	Screw, pan-head: size 0-40. (Part of S705).

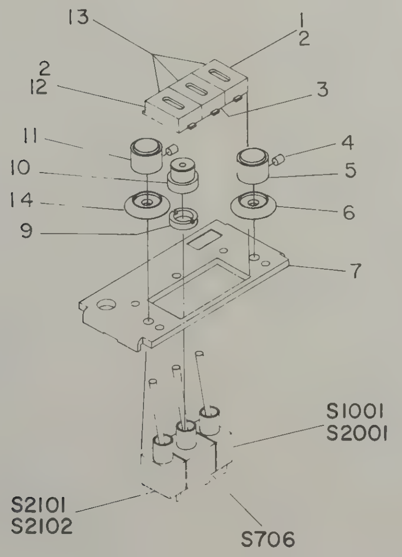
*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

PARTS LIST

TOP COVER ASSEMBLY
(Can not be ordered as an assembly)
(SEE RC3854)
ISSUE 3

SYMBOL	GE PART NO.	DESCRIPTION
1	19B232996G3	Decorative cap. (Channel Guard).
2	19B232996G5	Decorative cap. (VOX).
3	19B232996G1	Decorative cap. (2 Frequency).
4	N70P702C6	Set screw: No. 3-48 x 1/8.
5	19C328108P1	Knob. (Volume).
6	19C328193P2	Dial, scale. (min - max).
7	19D429335P1	Top plate.
9	19A127319P6	Nut: 1/4-40. (Used with 2 frequency switch S706).
10	19B232508P1	Seal. (Used with S706, S1001, S2101, S2102 switches).
11	19C328108P2	Knob. (Squelch).
12	19B232996G4	Decorative cap. (Hi-Ds).
13	19B232517P1	Dummy cap.
14	19C328193P3	Dial, scale.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES



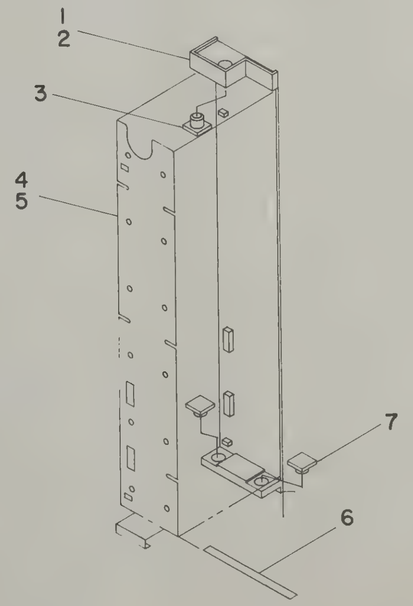
RC-3854B

PARTS LIST

RIGHT SIDE RAIL
19C328376G2 B CASE
19C328376G3 C CASE
(SEE RC3852)
ISSUE 3

SYMBOL	GE PART NO.	DESCRIPTION
1	19D429242P2	Side rail. (B CASE).
2	19D429242P3	Side rail. (C CASE).
4	19C328322P2	Shield. (B CASE).
5	19C328322P3	Shield. (C CASE).
6	19A137609G1	Strap.
7	19A137410P1	Bushing. (Secures base assembly & top plate to right side rail- Not included with side rail).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES



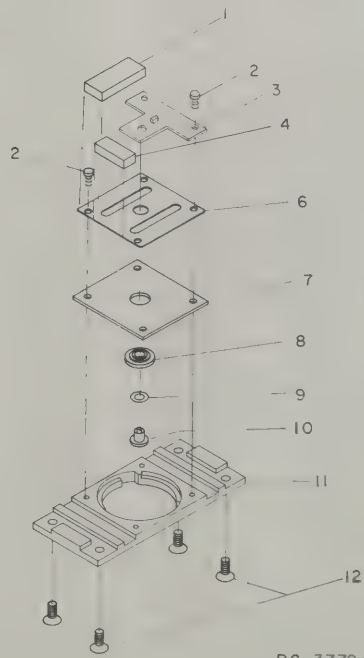
RC-3852

PARTS LIST

BASE ASSEMBLY
19C328377G1
(SEE RC3779)
ISSUE 3

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C1	19A700007P65	Ceramic: 150 pf ±5%, 50 VDCW; temp coef 0 ±30 Parts/M/°C.
		MECHANICAL PARTS
1	19B232682P5	Pad.
2	19A134793P1804	Tap screw, thd. forming (Metric).
3	19C330619P1	Printed board.
4	19B232682P11	Pad.
6	19B232497P1	Spring.
7	19B237706P1	Pad.
8	19A137490P1	Insulator.
9	4035306P70	Washer, non-metallic.
10	19A137531P1	Contact.
11	19D429248P1	Base.
12	19A134586P2506	Machine screw: 2.5 with 0.45 thd. pitch, 6MM long- Not included with base assembly).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES



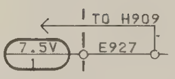
RC-3779A

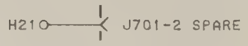
PRODUCTION CHANGES

Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter," which is stamped after the model number of the unit. The revision stamped on the unit includes all previous revisions. Refer to the Parts List for descriptions of parts affected by these revisions.

REV. A - System Board 19C328418G1 & G2
To add fuse inside of MPR.
Added F1.

Schematic Diagram was:





MOBILE RADIO

LBI30888
(DF8416)

INSTALLATION INSTRUCTIONS
FOR
MRP FIXED SQUELCH KIT 19A138539G1

This publication provides installation instructions and parts list for MPR Fixed Squelch Kit 19A138539G1.

The Fixed Squelch option consists of variable resistor R2301 and "push" switch S2301. Variable resistor R2301 replaces R702. S2301 connects between the $\overline{\text{RUS}}$ control lead and ground. When S2301 is pushed, the $\overline{\text{RUS}}$ control lead is forced low and the receive circuit unsquelches.

GENERAL ELECTRIC COMPANY • MOBILE COMMUNICATIONS DIVISION
WORLD HEADQUARTERS • LYNCHBURG, VIRGINIA 24502 U.S.A.

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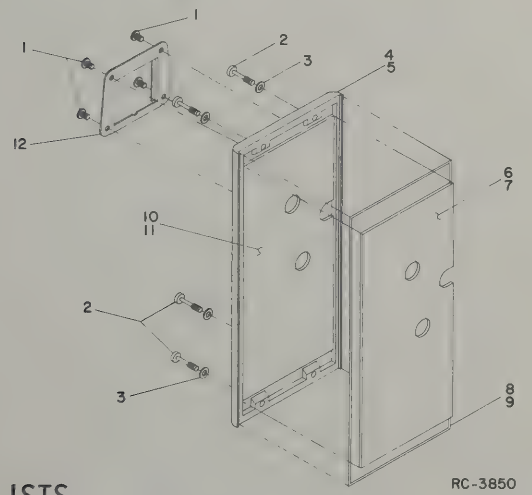
PARTS LIST

REAR COVER
19D429534G2 B CASE
19D429534G3 C CASE
(SEE RC3850)
ISSUE 2

SYMBOL	GE PART NO.	DESCRIPTION
1	N327P9010E	Rivet, tubular.
2	19A137412P1	Machine screw: M2.5 - .45 x 13MM.
3	19A134657P2	Lockwasher, Metric: size 2.5.
4	19C328374G2	Rear cover. (B CASE).
5	19C328374G3	Rear cover. (C CASE).
6	19B232524P3	Pad. (B CASE).
7	19B232524P5	Pad. (C CASE).
8	19A134583P2	Seal, rubber. (B CASE).
9	19A134583P3	Seal, rubber. (C CASE).
10	19B233545P2	Pad. (B CASE).
11	19B233545P3	Pad. (C CASE).
12	19B233216P1	Option, receptacle.
13	19A134285P1	Tape, pressure sensitive.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES



RC-3850

PARTS LIST

FRONT COVER ASSEMBLY
19D429544G2 (B CASE)
19D429544G3 (C CASE)
ISSUE 2

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - - CAPACITORS - - - - - - - - -
C1 and C2	19A700226P53	Ceramic: 47 pf ±5%, 100 VDCW, temp coef -750 PPM.
		- - - - - - - - - - LOUDSPEAKERS - - - - - - - - -
LS1	19A134460P1	Permanent magnet: 2 inch, 8 ohms ±10% voice coil imp, 400-3000 Hz freq range; sim to Pioneer A50AP1301F.
		- - - - - - - - MICROPHONES - - - - - - - - - -
MK1	19A134461P1	Cartridge, electret: 200 to 1000 ohms imp at 1 KHz; sim to Primo EM-60.
		- - - - - - - - - - - - - PLUGS - - - - - - - - -
P901	19A134584P2	Connector, plug: stranded wire No. 28 AWG, 3 amps max.
		MECHANICAL PARTS (SEE RC3851)
1	19A134583P2	Seal, rubber. (B CASE).
2	19A134583P3	Seal, rubber. (C CASE).
3	19D429314P1	Speaker boot.
4	19A134584P2	Connector, plug. (P901).
5	19A134793P1804	Tap screw, thd. forming (Metric).
[illegible]	19B232496P1	Speaker retaining plate.
7	19A134460P1	Speaker, permanent magnet. (LS1).
8	19A137709P1	Spacer.
9	19C328382G2	RF Cover. (B CASE).
10	19C328382G3	RF Cover. (C CASE).
11	19D429300P1	Grille.
12	19B232816P1	Pad. (B CASE).
13	19B232816P2	Pad. (C CASE).
14	19B232498P1	Mike boot.
15	19A134461P1	Microphone. (MK1).
16	4033714P14	Solderless terminal.
17	19A121175P15	Insulator, plate.

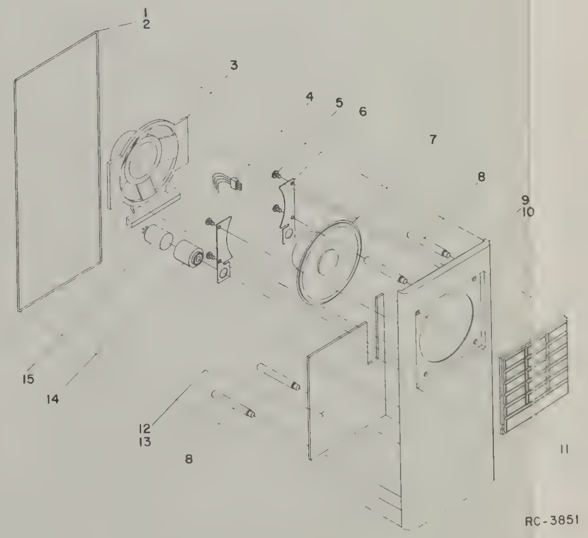
*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

PARTS LIST

MPX HIGH BAND ANTENNA
19B233322G1-G10
ISSUE 2

SYMBOL	GE PART NO.	DESCRIPTION
	19B233322G1	138-142 MHz.
	19B233322G2	142-146 MHz.
	19B233322G3	146-149 MHz.
	19B233322G4	149-152 MHz.
	19B233322G5	152-156 MHz.
	19B233322G6	156-158 MHz.
	19B233322G7	158-162 MHz.
	19B233322G8	162-166 MHz.
	19B233322G9	166-170 MHz.
	19B233322G10	170-174 MHz.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES



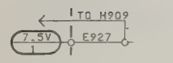
RC-3851

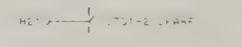
PRODUCTION CHANGES

Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter," which is stamped after the model number of the unit. The revision stamped on the unit includes all previous revisions. Refer to the Parts List for descriptions of parts affected by these revisions.

REV. A - System Board 19C328418G1 & G2
To add fuse inside of MPR.
Added F1.

Schematic Diagram was





MOBILE RADIO

LBI30888
(DF8416)

INSTALLATION INSTRUCTIONS
FOR
MRP FIXED SQUELCH KIT 19A138539G1

This publication provides installation instructions and parts list for MPR Fixed Squelch Kit 19A138539G1.

The Fixed Squelch option consists of variable resistor R2301 and "push" switch S2301. Variable resistor R2301 replaces R702. S2301 connects between the $\overline{\text{RUS}}$ control lead and ground. When S2301 is pushed, the $\overline{\text{RUS}}$ control lead is forced low and the receive circuit unsquelches.

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WORLD HEADQUARTERS • LYNCHBURG, VIRGINIA 24502 U.S.A.

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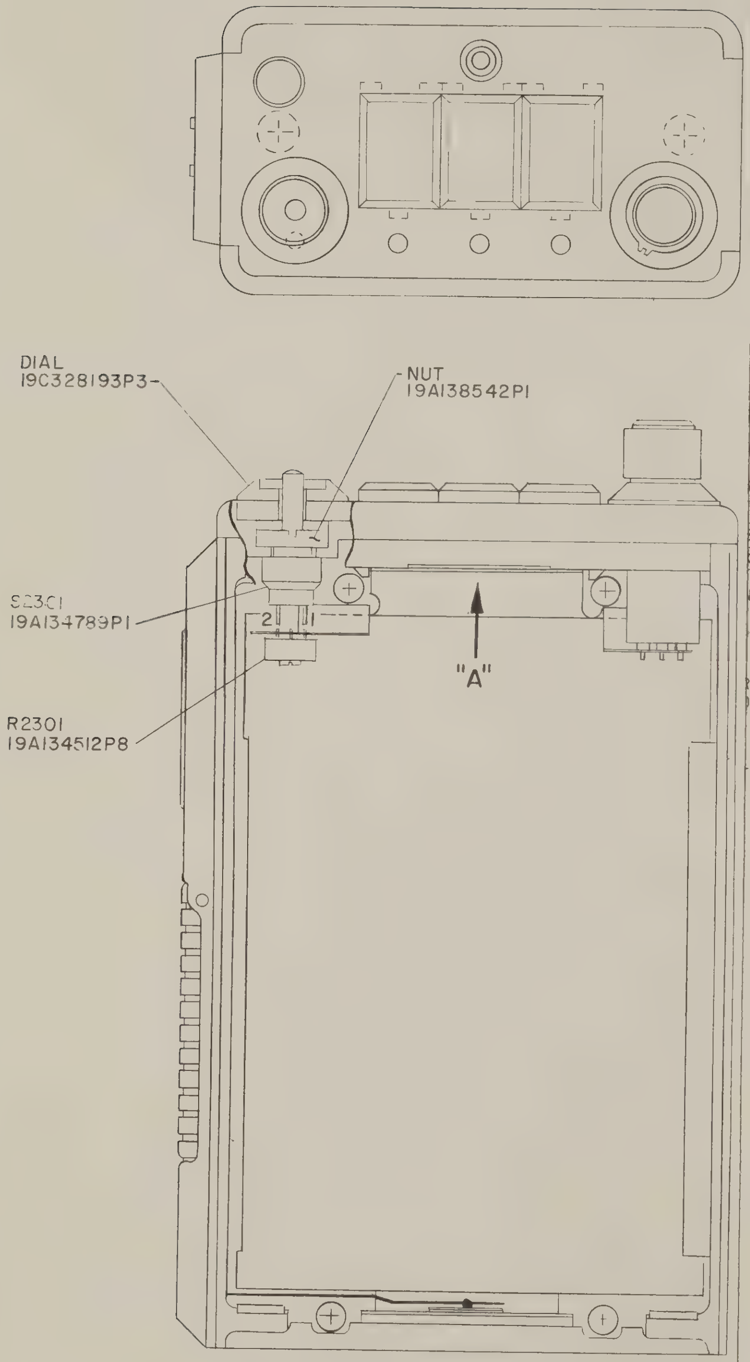
DIAL
19C328193P3
NUT
19A138542P1
S2301
19A134789P1
2
1
"A"
R2301
19A134512P8

LLATION OF HARDWARE KIT
IXED SQUELCH TO MPR "A"

ND BACK COVERS, IF PRESENT.

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'01 AS SHOWN.

HOWN.

ROM CHART BELOW.

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NS.

Q DIAL PER P7F-EA101 (THE ONE
DIAL TO TOP COVER AS SHOWN.

RE REMOVAL OF THE TOP COVER HAVE BEEN
INSTALL KNOBS AND FRONT AND BACK OVERS.

TION.

INSTALLATION INSTRUCTIONS

Sheet 1

SYMBOL	GE PART N
R2301	19A134512P8
S2301	19A134789P1
	19A138542P1
	19C328193P3

THESE INST
PL19A1385
CASE.

* 1. REMOVE
IF PR

2. REMO

3. INST

4. INST

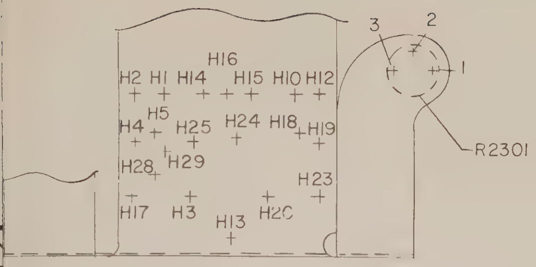
5. CONN

6. SOLD

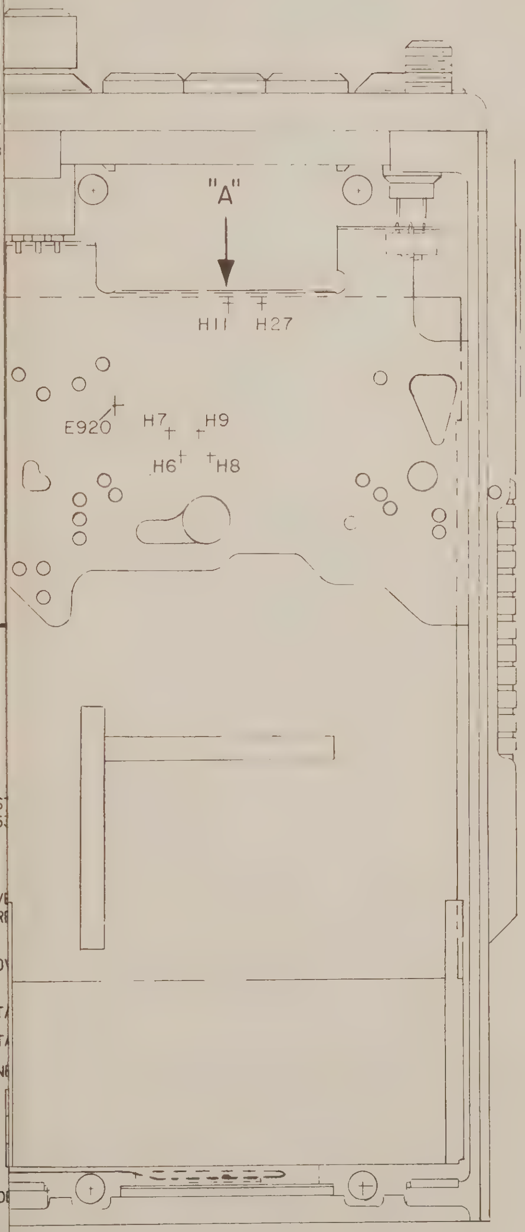
7. APPL
(THE
COVE

* 8. IF A
HAVE
AND

*


H16
H2 H1 H14 H15 H10 H12
H5
H4 H25 H24 H18 H19
H28 H29
H23
H17 H3 H2C
H13
3
2
1
R2301

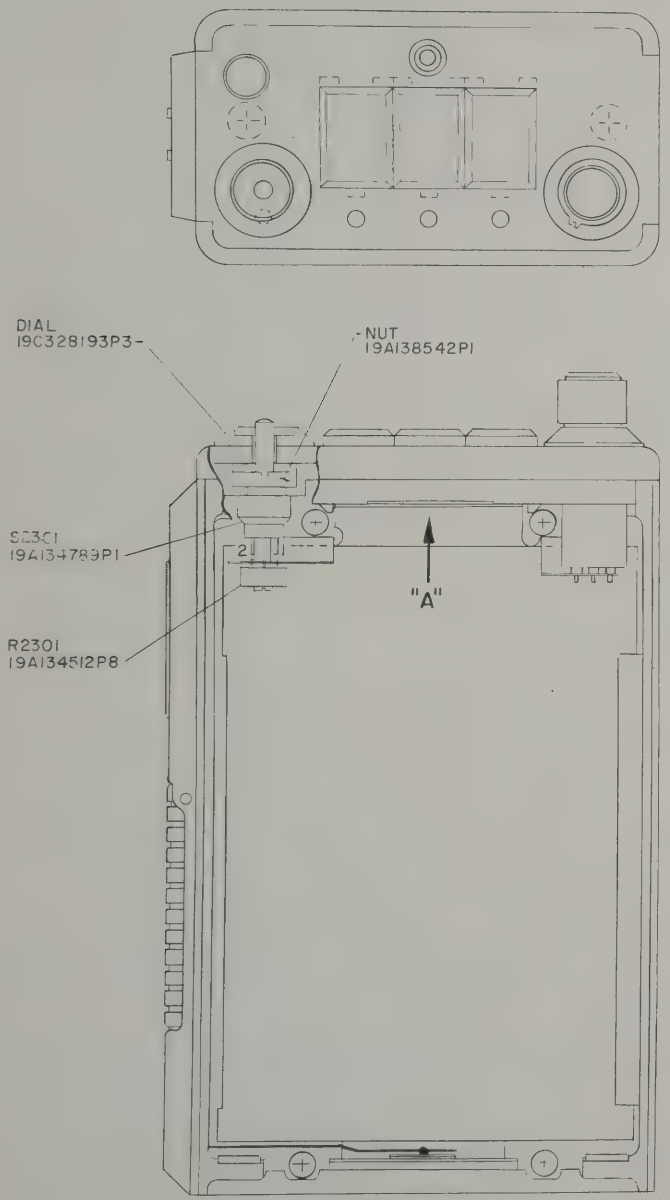
VIEW AT "A"

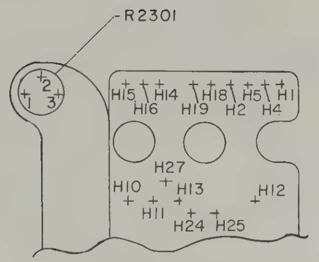

"A"
H11 H27
E920
H7 H9
H6 H8

INSTALLATION INSTRUCTIONS

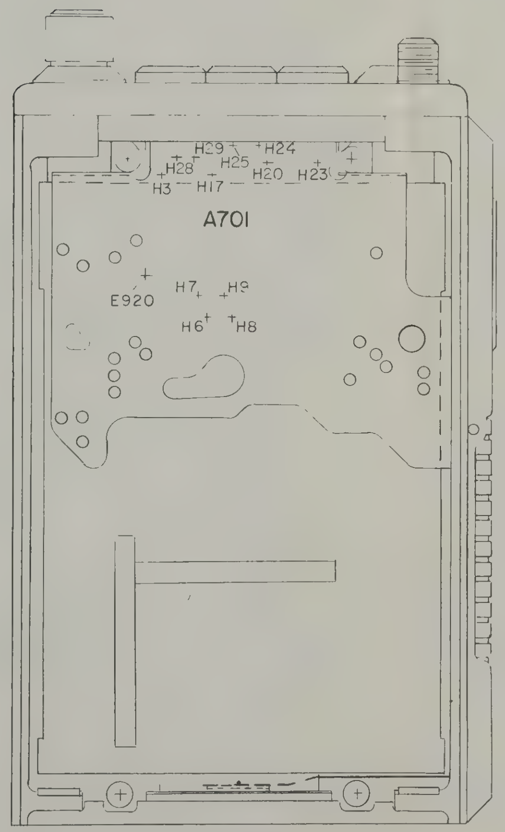
Sheet 2

Issue 1


DIAL
19C328193P3
NUT
19A138542P1
S2301
19A134789P1
R2301
19A134512P8
"A"
2
1


R2301
1
2
3
H15
H14
H18
H5
H1
H16
H19
H2
H4
H27
H10
H13
H12
H11
H24
H25

VIEW AT "A"


H29
H24
H28
H25
H20
H23
H3
H17
A701
E920
H7
H9
H6
H8

THESE INSTRUCTIONS COVER THE INSTALLATION OF HARDWARE KIT PL19A138539G1 FOR APPLICATION OF FIXED SQUELCH TO MPR "A" CASE.

* 1. REMOVE KNOBS, TOP COVER, FRONT AND BACK COVERS, IF PRESENT.

2. REMOVE SQUELCH POT R702 AND DIAL.

3. INSTALL R2301 ON FLEX CIRCUIT A701 AS SHOWN.

4. INSTALL S2301 IN TOP PLATE AS SHOWN.

5. CONNECT S2301 TO FLEX CIRCUIT FROM CHART BELOW.

FROM	TO	WIRE
E920	S2301-1	T28-WBL
A701-H15	S2301-2	T28-BK

6. SOLDER ALL ELECTRICAL CONNECTIONS.

7. APPLY ADHESIVE TO UNDERSIDE OF SQ DIAL PER P7F-EA101 (THE ONE REMOVED IN STEP 2) AND ASSEMBLE DIAL TO TOP COVER AS SHOWN.

* 8. IF ALL OTHER OPTIONS THAT REQUIRE REMOVAL OF THE TOP COVER HAVE BEEN INSTALLED, SNAP ON TOP COVER AND INSTALL KNOBS AND FRONT AND BACK COVERS.

* REQUIRED IN FIELD INSTALLATION.

(19D429326, Sh. 1, Rev. 2)

INSTALLATION INSTRUCTIONS

Sheet 1

Issue 1

PARTS LIST

FIXED SQUELCH KIT
19A138539G1
ISSUE 1

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - RESISTORS - - - - - - - - -
R2301	19A134512P8	Variable, cermet: 50K ohms ±10%, 0.5 w; sim to A-B A2A503.
		- - - - - - - - - - SWITCHES - - - - - - - - -
S2301	19A134789P1	Push: 250,000 operations at 0.1 amperes & 115 VAC; sim to Grayhill 39-YY-2307.
		- - - - - - - - - MISCELLANEOUS - - - - - - - -
	19A138542P1	Nut, hex: 8-40. (Secures S2301).
	19C328193P3	Dial. (Used with S2301).

THESE INSTRUCTIONS COVER THE INSTALLATION OF HARDWARE KIT PL19A138539G1 FOR APPLICATION OF FIXED SQUELCH TO MPR "B" + "C" CASE.

* 1. REMOVE KNOBS, TOP COVER, FRONT AND BACK COVERS, IF PRESENT.

2. REMOVE SQUELCH POT R702 AND DIAL.

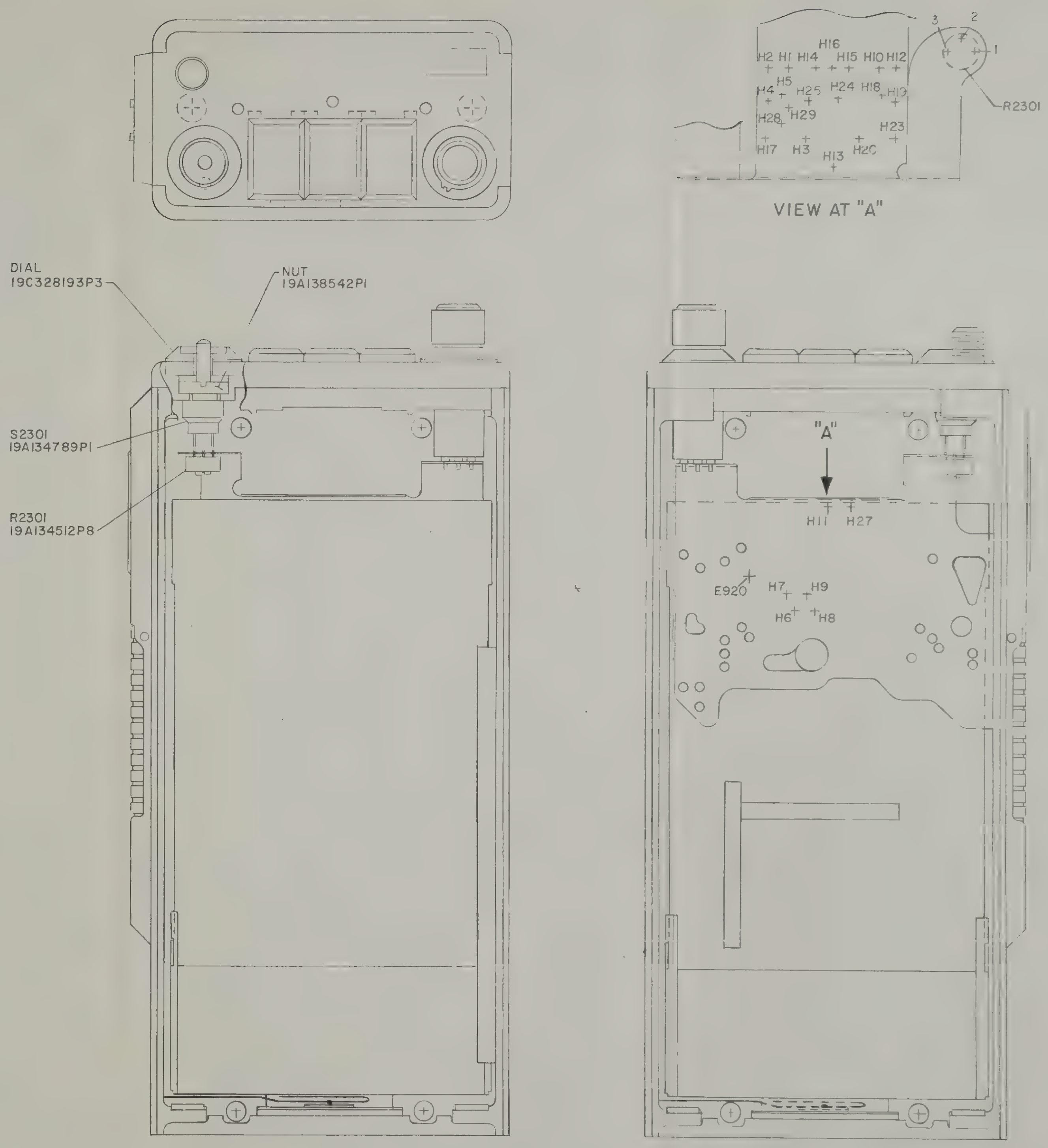
3. INSTALL R2301 ON FLEX CIRCUIT A702 AS SHOWN.
4. INSTALL S2301 IN TOP PLATE AS SHOWN
5. CONNECT S2301 TO FLEX CIRCUIT FROM CHART BELOW.

FROM	TO	WIRE
E920	S2301-1	T28-WBL
A702-H15	S2301-2	T28-BK

6. SOLDER ALL ELECTRICAL CONNECTIONS.

7. APPLY ADHESIVE TO UNDERSIDE OF SQ DIAL PER P7F-EA101 (THE ONE REMOVED IN STEP 2) AND ASSEMBLE DIAL TO TOP COVER AS SHOWN.
* 8. IF ALL OTHER OPTIONS THAT REQUIRE REMOVAL OF THE TOP COVER HAVE BEEN INSTALLED, SNAP ON TOP COVER AND INSTALL KNOBS AND FRONT AND BACK COVERS.

* REQUIRED IN FIELD INSTALLATION.


DIAL
19C328193P3
NUT
19A138542P1
S2301
19A134789P1
R2301
19A134512P8
H16
H2 H1 H14 H15 H10 H12
H5
H4
H25
H24
H18
H19
H28
H29
H23
H17
H3
H13
H20
3
2
1
R2301
VIEW AT "A"
"A"
H11
H27
E920
H7
H9
H6
H8

(19D429326, Sh. 2, Rev.2)

INSTALLATION INSTRUCTIONS

Sheet 2

INSTALLATION INSTRUCTIONS
FOR
MPR CHANNEL GUARD HARDWARE KIT
19A137835G1 & G2

This publication provides installation instructions and parts list for MPR Channel Guard Hardware Kit 19A137835G1 & G2.

Hardware Kit 19A137835 is for one-tone Channel Guard encode only or one-tone Channel Guard encode/decode applications under structured options C & D.

Refer to the applicable maintenance manual for Structured Option Nomenclature.

Hardware Kit 19A137835G1 is for encode only applications and Hardware Kit 19A137835G2 is for encode/decode applications.

To program the Channel Guard Module for the desired tone refer to the applicable maintenance manual for the Channel Guard Programming Procedure.

GENERAL ELECTRIC COMPANY• MOBILE COMMUNICATIONS DIVISION
WORLD HEADQUARTERS• LYNCHBURG, VIRGINIA 24502 U.S.A.

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Printed in U.S.A.

MOBILE RADIO

LB130894
(DF5053)

INSTALLATION INSTRUCTIONS
FOR
MPR CHANNEL GUARD HARDWARE KIT
19A137835G1 & G2

This publication provides installation instructions and parts list for MPR Channel Guard Hardware Kit 19A137835G1 & G2.

Hardware Kit 19A137835 is for one-tone Channel Guard encode only or one-tone Channel Guard encode/decode applications under structured options C & D.

Refer to the applicable maintenance manual for Structured Option Nomenclature.

Hardware Kit 19A137835G1 is for encode only applications and Hardware Kit 19A137835G2 is for encode/decode applications.

To program the Channel Guard Module for the desired tone refer to the applicable maintenance manual for the Channel Guard Programming Procedure.

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WORLD HEADQUARTERS • LYNCHBURG, VIRGINIA 24502 U.S.A.

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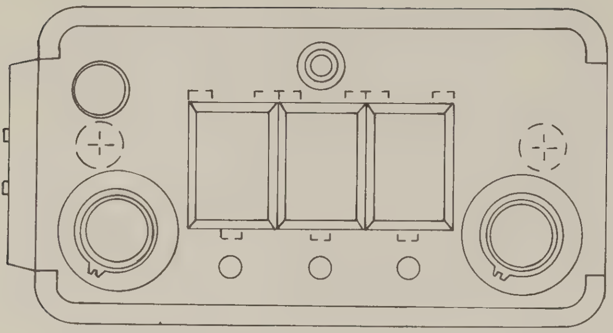
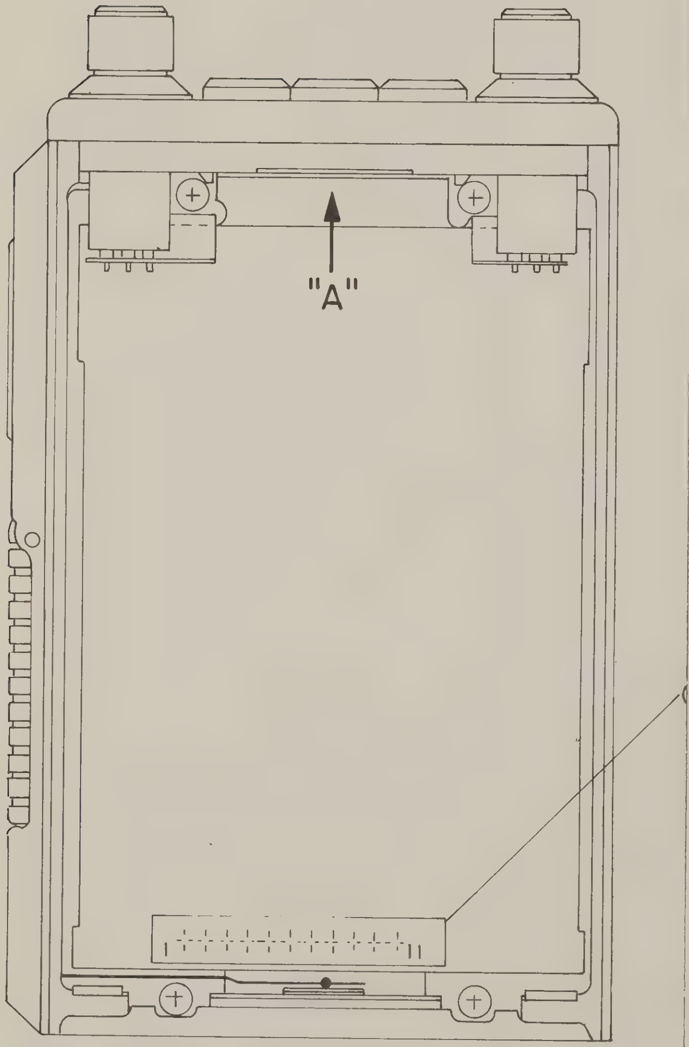




LATION OF HARDWARE KIT
F CHANNEL GUARD (CG)
THE "A" CASE MPR.

AND DUMMY CG BLOCK, IF PRESENT.

TEM BOARD BETWEEN PIN 3 AND PIN

TWEEN A701-H1 AND A701-H2 AS

OR FREQ. CODING CG.

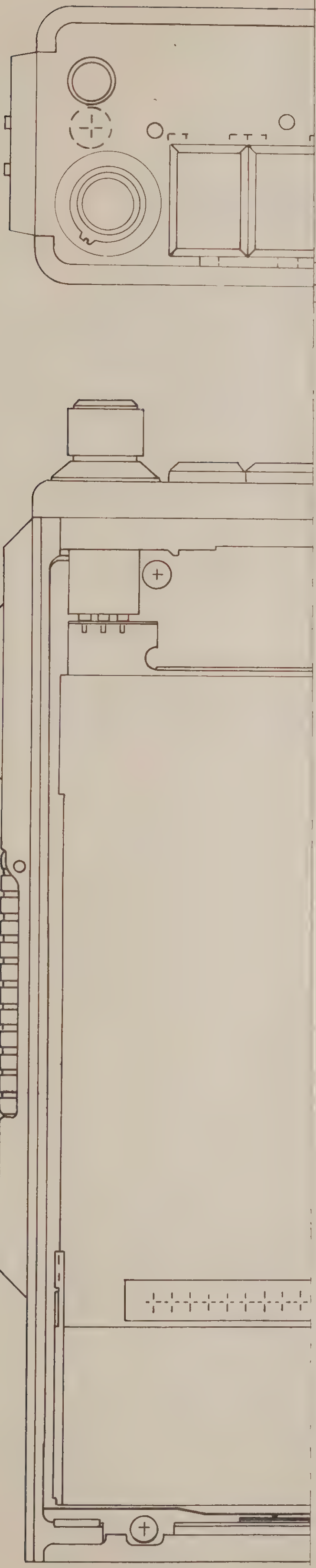
OWN.

.

ATION.

INSTALLATION INSTRUCTIONS

Sheet 1



HESE INSTRUCTIONS COVER THE INSTALLATION OF HARDWARE KIT
19A137835G1 FOR THE APPLICATION OF CHANNEL GUARD (CG)
19D429618G1 ENCODE (ENC) ONLY IN THE "B & C" CASE MPR

* 1. REMOVE FRONT AND BACK COVER AND DUMMY CG BLOCK, IF PRESENT.

2. CUT RUN ON SOLDER SIDE OF SYSTEM BOARD BETWEEN PIN 3 AND PIN 5 OF CG AS SHOWN.

3. ADD A JUMPER USING DM WIRE BETWEEN A702-H1 AND A702-H2 AS SHOWN.

4. USE INSTRUCTIONS ON SHEET 3 FOR FREQ CODING CG.

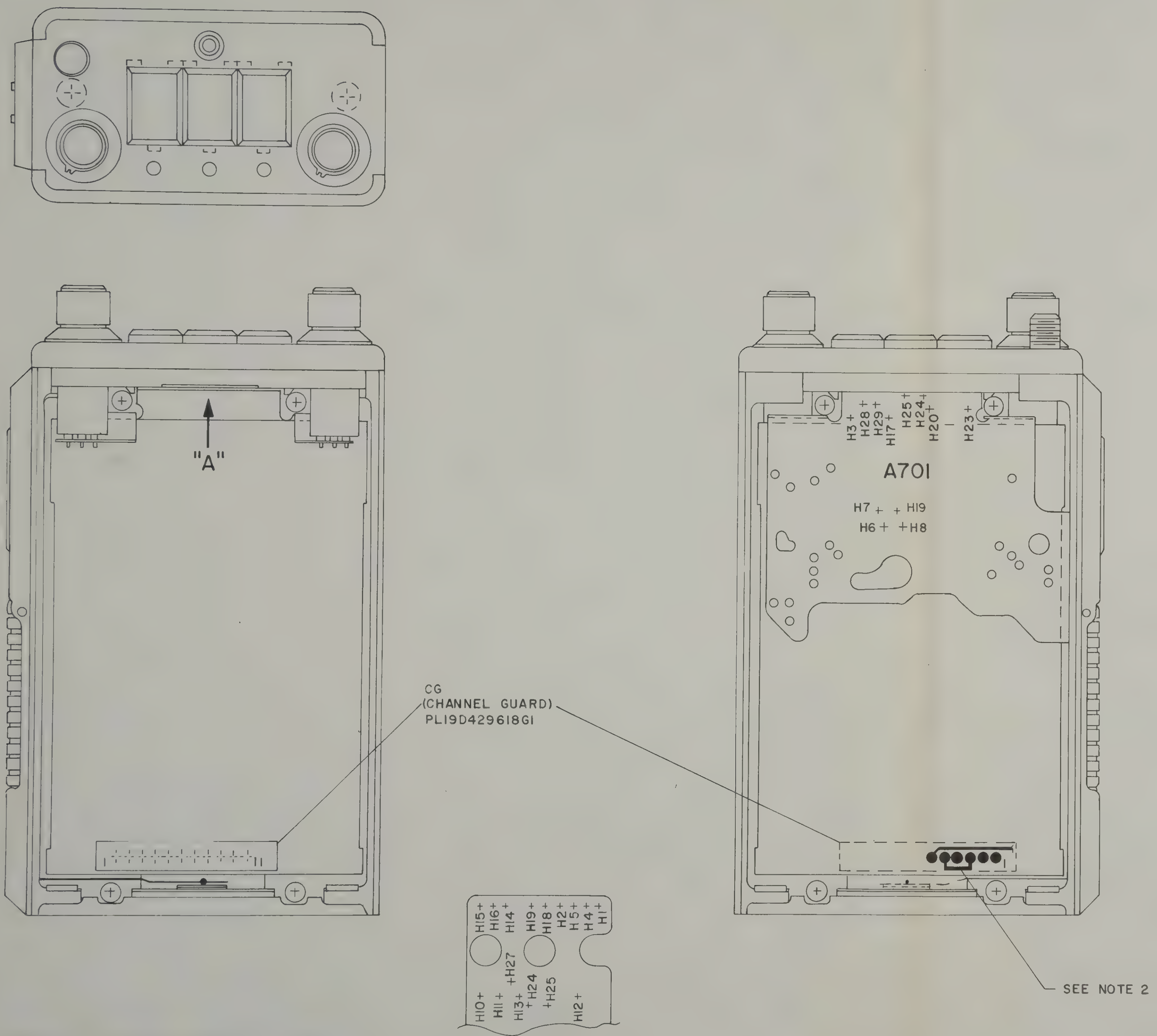
5. PLUG IN CG MODULE IN POSITION SHOWN.

* 6. INSTALL FRONT AND BACK COVERS.

* REQUIRED IN FIELD INSTALLATION.

INSTALLATION INSTRUCTIONS

Sheet 2


"A"
CG
(CHANNEL GUARD)
PL19D429618G1
H3
H28
H29
H17
H25
H24
H20
H23
A701
H7
H19
H6
H8
H15
H16
H14
H19
H18
H2
H5
H4
H1
H27
H24
H25
H10
H11
H13
H12
SEE NOTE 2

VIEW AT "A"

THESE INSTRUCTIONS COVER THE INSTALLATION OF HARDWARE KIT PL19A137835G1 FOR THE APPLICATION OF CHANNEL GUARD (CG) PL19D429618G1 ENCODE (ENC) ONLY IN THE "A" CASE MPR.

* 1. REMOVE FRONT AND BACK COVERS AND DUMMY CG BLOCK, IF PRESENT.

2. CUT RUN ON SOLDER SIDE OF SYSTEM BOARD BETWEEN PIN 3 AND PIN 5 OF CG ASH SHOWN.

3. ADD A JUMPER USING DM WIRE BETWEEN A701-H1 AND A701-H2 AS SHOWN.

4. USE INSTRUCTIONS ON SHEET 3 FOR FREQ. CODING CG.

5. PLUG CG MODULE IN POSITION SHOWN.

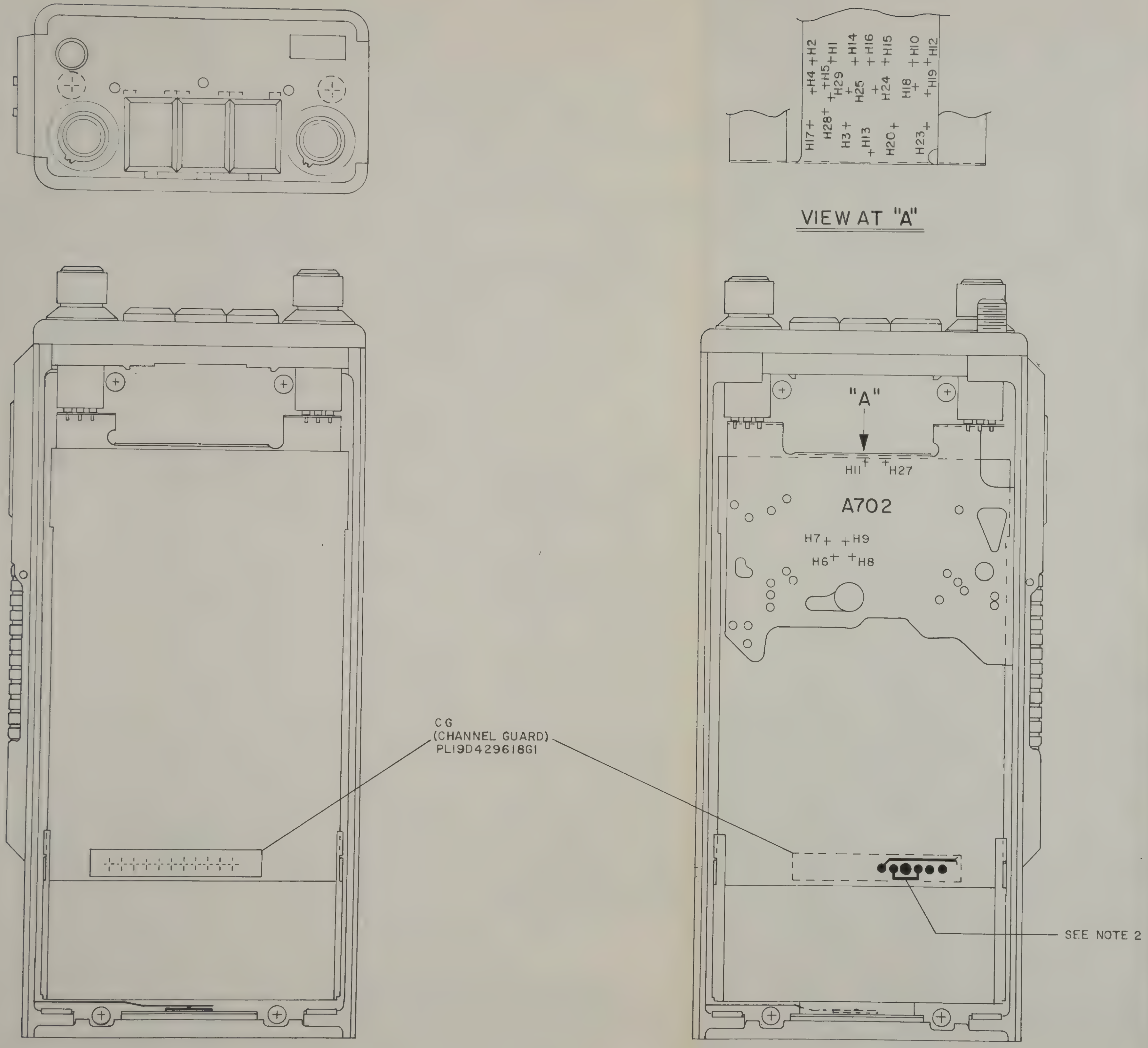
* 6. INSTALL FRONT AND BACK COVERS.

* REQUIRED IN FIELD INSTALLATION.

INSTALLATION INSTRUCTIONS

Sheet 1

(19D429867, Sh. 1, Rev. 1)


H4 +H2
+H5 +H1
H29
H14
H16
H25
H15
H24
H10
H18
H19 +H12
H17
H28
H3
H13
H20
H23
VIEW AT "A"
"A"
H11
H27
A702
H7 H9
H6 H8
CG
(CHANNEL GUARD)
PL19D429618G1
SEE NOTE 2

(19D429867, Sh. 2, Rev. 1)

THESE INSTRUCTIONS COVER THE INSTALLATION OF HARDWARE KIT PL19A137835G1 FOR THE APPLICATION OF CHANNEL GUARD (CG) PL19D429618G1 ENCODE (ENC) ONLY IN THE "B & C" CASE MPR

* 1. REMOVE FRONT AND BACK COVER AND DUMMY CG BLOCK, IF PRESENT.

2. CUT RUN ON SOLDER SIDE OF SYSTEM BOARD BETWEEN PIN 3 AND PIN 5 OF CG AS SHOWN.

3. ADD A JUMPER USING DM WIRE BETWEEN A702-H1 AND A702-H2 AS SHOWN.

4. USE INSTRUCTIONS ON SHEET 3 FOR FREQ CODING CG.

5. PLUG IN CG MODULE IN POSITION SHOWN.

* 6. INSTALL FRONT AND BACK COVERS.

* REQUIRED IN FIELD INSTALLATION.

INSTALLATION INSTRUCTIONS

Sheet 2

Issue 1

)VER THE FREQ CODING FOR C. G. MODULE
;TANDARD C. G. FREQ.

INS (19B219681), PER FIG. 1, IN POSITIONS
IN CHART 1, WHICH AGREES WITH DESIRED CG
4PLE SHOWN FOR 127.3Hz).

:OVER (19D429521P1).

TABS ABOVE COVER BY BENDING TOWARD EITHER
) NOT BEND TAB TOWARD SIDE OF MODULE).

CG FREQ ON LABEL (NP280529) AND ASSEMBLE
)F COVER. (EXAMPLE 127.3)

CHART 1

FREQ CHART									
CONTACT PIN POSITION									
9	8	7	6	5	4	3	2	1	0
X		X	X	X	X			X	X
X		X	X		X	X	X	X	X
X		X	X			X		X	X
X		X		X	X		X		X
X		X			X	X	X		X
X		X					X		
X			X	X		X	X	X	X
X			X	X					X
X			X		X			X	
X			X					X	X
X				X	X		X		
X				X			X		
X					X			X	X
X								X	
	X	X	X	X	X				
	X	X	X		X	X	X		X
	X	X	X			X		X	
	X	X		X	X		X	X	
	X	X		X					X
	X	X				X	X		
	X		X	X	X		X	X	
	X		X		X	X	X	X	X
	X		X			X			
	X			X		X	X	X	X
	X				X		X	X	
		X	X	X	X	X	X		
		X	X		X				X
		X		X	X		X		

THESE INSTRUCTIONS COVER THE FREQ CODING FOR CG MODULE 19D429618
USING THE NON STANDARD CG FREQ.

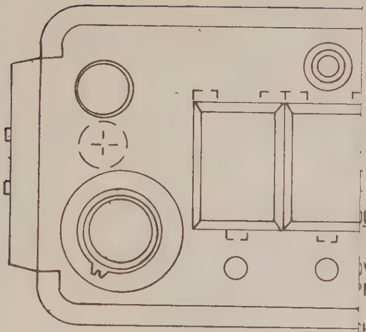
1. USE CHART 2 TO CALCULATE THE CG FREQ DESIRED.
2. FIND THE FREQ DESIRED BY ADDING UP THE FREQ IN CHART 2. ABOVE EACH FREQ IS A CONTACT PIN POSITION NUMBER, IF THIS POSITION IS OPEN (THAT IS A PIN IS NOT INSTALLED), THE CG WILL PRODUCE THAT FREQ. IF MORE THAN ONE IS LEFT OPEN, THE OUTPUT FREQ WILL BE THE SUM OF THE OPEN POSITIONS.

   EXAMPLE: CG FREQ 128Hz THEREFORE CONTACT PIN POSITION #9 WILL BE OPEN AND CONTACT PINS WILL BE INSTALLED IN POSITION 0, 1, 2, 3, 4, 5, 6 ,7 AND 8.

   EXAMPLE: CG FREQ 132.75Hz. THEREFORE CONTACT PIN POSITION #9 WHICH IS 128, #4 WHICH IS 4, #1 WHICH IS .5, AND #0 WHICH IS .25 WILL BE OPEN. ADD THE FREQ 128 + 4 + .5 + .25 = 132.75. CONTACT PINS WILL BE INSTALLED IN POSITION #2, 3, 5, 6, 7 AND 8.
3. INSTALL CONTACT PINS, ASSEMBLE COVER AND STAMP LABEL PER INSTRUCTIONS FOR FREQ CODING THE STANDARD CG FREQ.

CHART 2

9	8	7	6	5	4	3	2	1	0	CONTACT PIN POSITION
128	64	32	16	8	4	2	1	.5	.25	FREQ IN Hz



IONS COVER THE INSTALLATION OF HARDWARE KIT PL19A137835G2 FOR
CHANNEL GUARD (CG) PL19D429618G1 ENC/DEC IN THE "A" CASE MPR
NITOR.

VE KNOBS, TOP COVER, FRONT AND BACK COVERS AND DUMMY BLOCK,
RESENT.

H OUT HOLE IN TOP PLATE AT POSITION SHOWN.

ALL S1001 SWITCH IN POSITION SHOWN.

ECT SWITCH TO FLEX CIRCUIT FROM CHART BELOW:

FROM	TO	WIRE
01-H1	S1001-3	T28 W-R
01-H2	S1001-2	T28 BK

STANDARD OPERATION, CUT RUN ON SOLDER SIDE OF SYSTEM BOARD BETWEEN
3 AND PIN 5 OF CG AS SHOWN. (THIS ALLOWS THE UNIT TO TX ENC WITH
CG SWITCH OFF).

T IS DESIRABLE TO TURN CG OFF, THAT IS, WITH THE CG SWITCH OFF, THE
WILL MONITOR ON RX AND DOES NOT TX ENC ON TX THEN OMIT STEP 5.

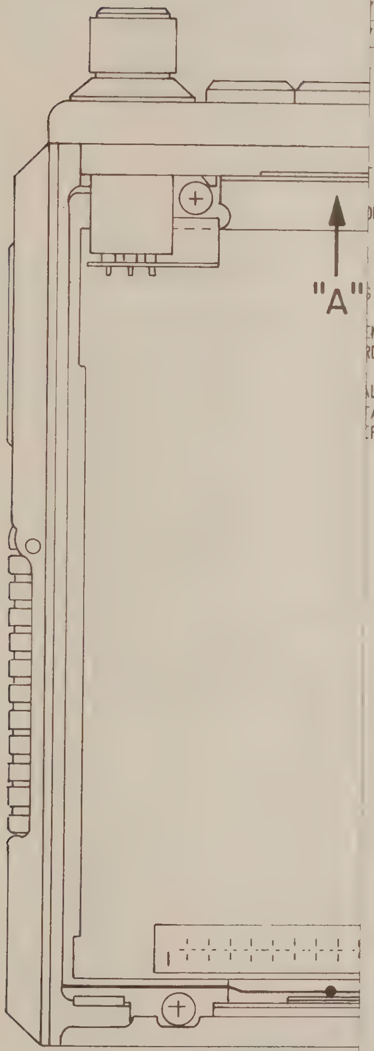
ER ALL ELECTRICAL CONNECTIONS.

INSTRUCTIONS ON SHEET 3 FOR FREQ CODING CG.

IN CG MODULE IN POSITION SHOWN.

MBLE SEAL OVER S1001 AND REPLACE BLANK MODULE WITH THE CHANNEL
RD MODULE.

LL OPTIONS THAT REQUIRE REMOVAL OF THE TOP COVER HAVE BEEN
ALLED, SNAP ON TOP COVER AND INSTALL KNOBS AND FRONT AND BACK
RS.



* REQUIRED IN FIELD INSTALLATION.

INSTALLATION INSTRUCTIONS

Sheet 4

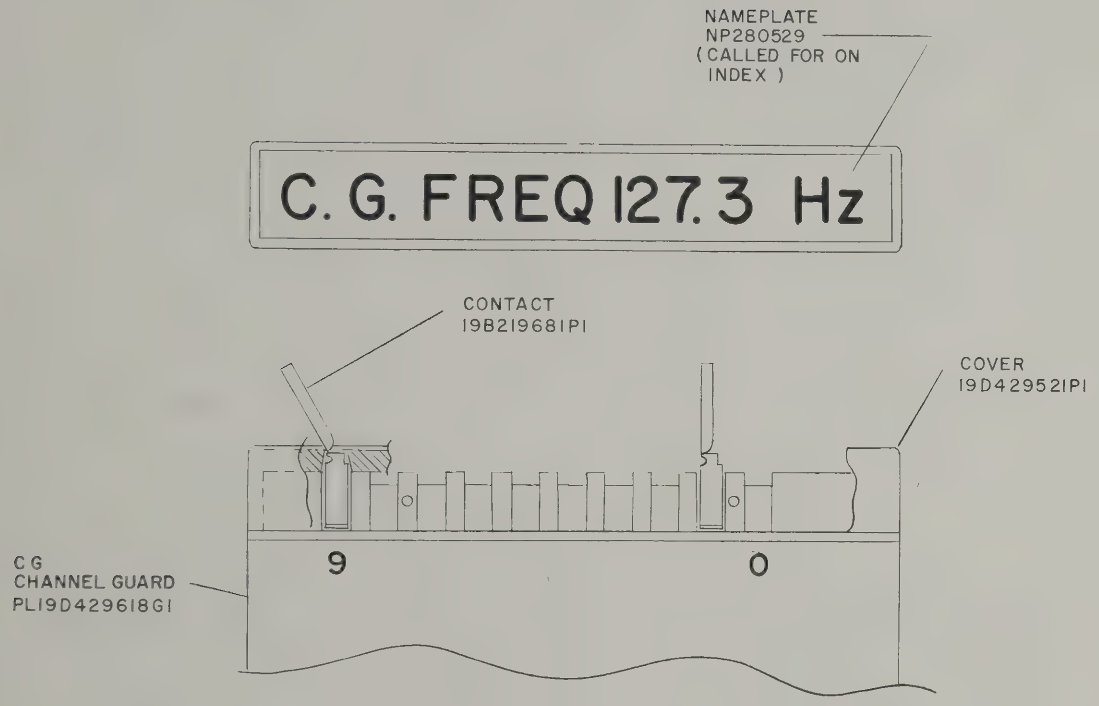


FIG. 1

THESE INSTRUCTIONS COVER THE FREQ CODING FOR C. G. MODULE 19D429618 USING THE STANDARD C. G. FREQ.

1. INSTALL CONTACT PINS (19B219681), PER FIG. 1, IN POSITIONS INDICATED BY "X" IN CHART 1, WHICH AGREES WITH DESIRED CG FREQ. (NOTE - EXAMPLE SHOWN FOR 127.3Hz).
2. ASSEMBLE SNAP ON COVER (19D429521P1).
3. BREAK OFF CONTACT TABS ABOVE COVER BY BENDING TOWARD EITHER END OF MODULE. (DO NOT BEND TAB TOWARD SIDE OF MODULE).
4. STAMP APPROPRIATE CG FREQ ON LABEL (NP280529) AND ASSEMBLE IN RECESS ON TOP OF COVER. (EXAMPLE 127.3)

CHART 1

FREQ CHART										
C.G.	CONTACT PIN POSITION									
FREQ	9	8	7	6	5	4	3	2	1	0
67	X		X	X	X	X			X	X
71.9	X		X	X		X	X	X	X	X
77	X		X	X			X		X	X
82.5	X		X		X	X		X		X
88.5	X		X			X	X	X		X
94.8	X		X					X		
100	X			X	X		X	X	X	X
103.5	X			X	X					X
107.2	X			X		X			X	
110.9	X			X					X	X
114.8	X				X	X		X		
118.8	X				X			X		
123	X					X			X	X
127.3	X								X	
131.8		X	X	X	X	X				
136.5		X	X	X		X	X	X		X
141.3		X	X	X			X		X	
146.2		X	X		X	X		X	X	
151.4		X	X		X					X
156.7		X	X				X	X		
162.2		X		X	X	X		X	X	
167.9		X		X		X	X	X	X	X
173.8		X		X			X			
179.9		X			X		X	X	X	X
186.2		X				X		X	X	
192.8			X	X	X	X	X	X		
203.5			X	X		X				X
210.7			X		X	X		X		

THESE INSTRUCTIONS COVER THE FREQ CODING FOR CG MODULE 19D429618 USING THE NON STANDARD CG FREQ.

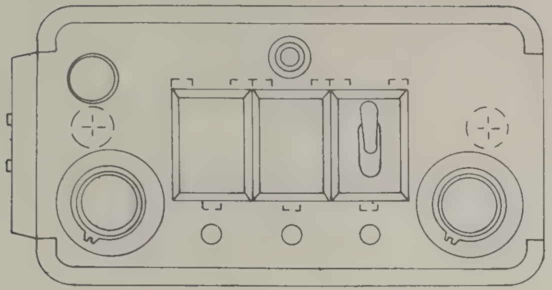
1. USE CHART 2 TO CALCULATE THE CG FREQ DESIRED.
2. FIND THE FREQ DESIRED BY ADDING UP THE FREQ IN CHART 2. ABOVE EACH FREQ IS A CONTACT PIN POSITION NUMBER, IF THIS POSITION IS OPEN (THAT IS A PIN IS NOT INSTALLED), THE CG WILL PRODUCE THAT FREQ. IF MORE THAN ONE IS LEFT OPEN, THE OUTPUT FREQ WILL BE THE SUM OF THE OPEN POSITIONS.

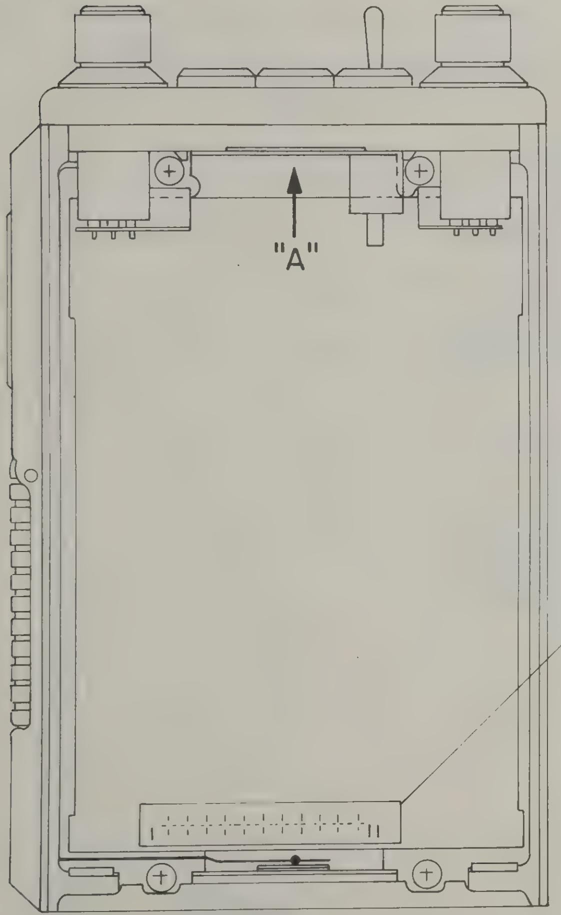
   EXAMPLE: CG FREQ 128Hz THEREFORE CONTACT PIN POSITION #9 WILL BE OPEN AND CONTACT PINS WILL BE INSTALLED IN POSITION 0, 1, 2, 3, 4, 5, 6 ,7 AND 8.

   EXAMPLE: CG FREQ 132.75Hz. THEREFORE CONTACT PIN POSITION #9 WHICH IS 128, #4 WHICH IS 4, #1 WHICH IS .5, AND #0 WHICH IS .25 WILL BE OPEN. ADD THE FREQ 128 + 4 + .5 + .25 = 132.75. CONTACT PINS WILL BE INSTALLED IN POSITION #2, 3, 5, 6, 7 AND 8.
3. INSTALL CONTACT PINS, ASSEMBLE COVER AND STAMP LABEL PER INSTRUCTIONS FOR FREQ CODING THE STANDARD CG FREQ.

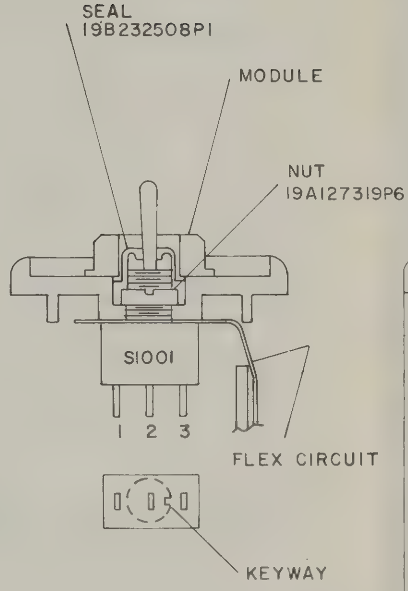
CHART 2

9	8	7	6	5	4	3	2	1	0	CONTACT PIN POSITION
128	64	32	16	8	4	2	1	.5	.25	FREQ IN Hz

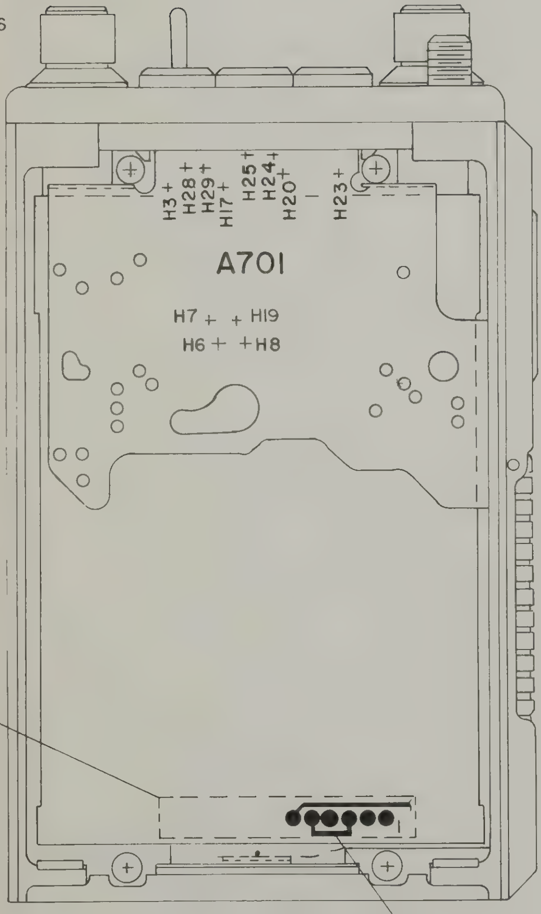




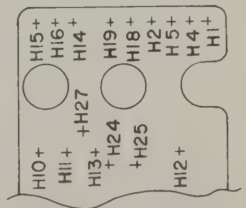
CG
(CHANNEL GUARD)
PL19D429618G1


SEAL
19B232508P1
MODULE
NUT
19A127319P6
S1001
1 2 3
FLEX CIRCUIT
KEYWAY

TYPICAL SWITCH MOUNTING


H3
H28
H29
H17
H25
H24
H20
H23
A701
H7
H19
H6
H8

SEE NOTES 5 & 6


H15
H16
H14
H19
H18
H2
H5
H4
H1
H27
H10
H11
H13
H24
H25
H12

VIEW AT "A"

THESE INSTRUCTIONS COVER THE INSTALLATION OF HARDWARE KIT PL19A137835G2 FOR APPLICATION OF CHANNEL GUARD (CG) PL19D429618G1 ENC/DEC IN THE "A" CASE MPR WITH MANUAL MONITOR.

* 1. REMOVE KNOBS, TOP COVER, FRONT AND BACK COVERS AND DUMMY BLOCK, IF PRESENT.

2. PUNCH OUT HOLE IN TOP PLATE AT POSITION SHOWN.

3. INSTALL S1001 SWITCH IN POSITION SHOWN.

4. CONNECT SWITCH TO FLEX CIRCUIT FROM CHART BELOW:

FROM	TO	WIRE
A701-H1	S1001-3	T28 W-R
A701-H2	S1001-2	T28 BK

5. FOR STANDARD OPERATION, CUT RUN ON SOLDER SIDE OF SYSTEM BOARD BETWEEN PIN 3 AND PIN 5 OF CG AS SHOWN. (THIS ALLOWS THE UNIT TO TX ENC WITH THE CG SWITCH OFF).

6. IF IT IS DESIRABLE TO TURN CG OFF, THAT IS, WITH THE CG SWITCH OFF, THE UNIT WILL MONITOR ON RX AND DOES NOT TX ENC ON TX THEN OMIT STEP 5.

7. SOLDER ALL ELECTRICAL CONNECTIONS.

8. USE INSTRUCTIONS ON SHEET 3 FOR FREQ CODING CG.

9. PLUG IN CG MODULE IN POSITION SHOWN.

10. ASSEMBLE SEAL OVER S1001 AND REPLACE BLANK MODULE WITH THE CHANNEL GUARD MODULE.

* 11. IF ALL OPTIONS THAT REQUIRE REMOVAL OF THE TOP COVER HAVE BEEN INSTALLED, SNAP ON TOP COVER AND INSTALL KNOBS AND FRONT AND BACK COVERS.

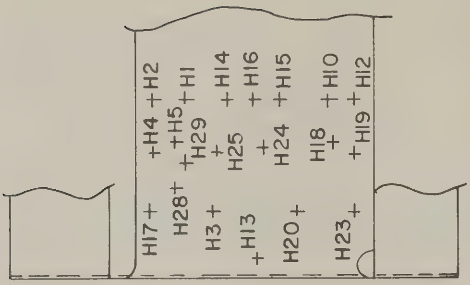
* REQUIRED IN FIELD INSTALLATION.

(19D429867, Sh. 4, Rev. 1)

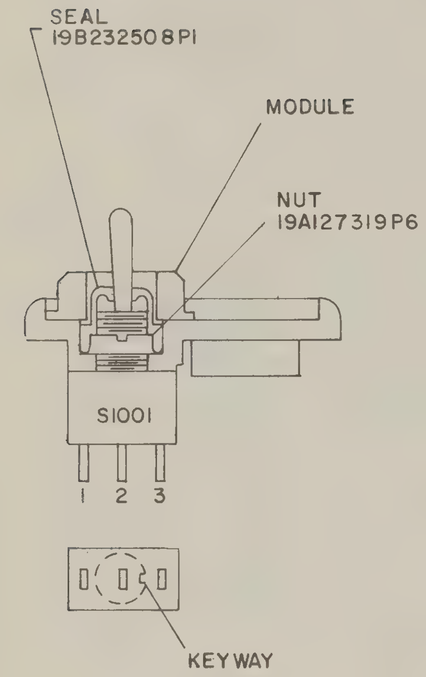
INSTALLATION INSTRUCTIONS

Sheet 4

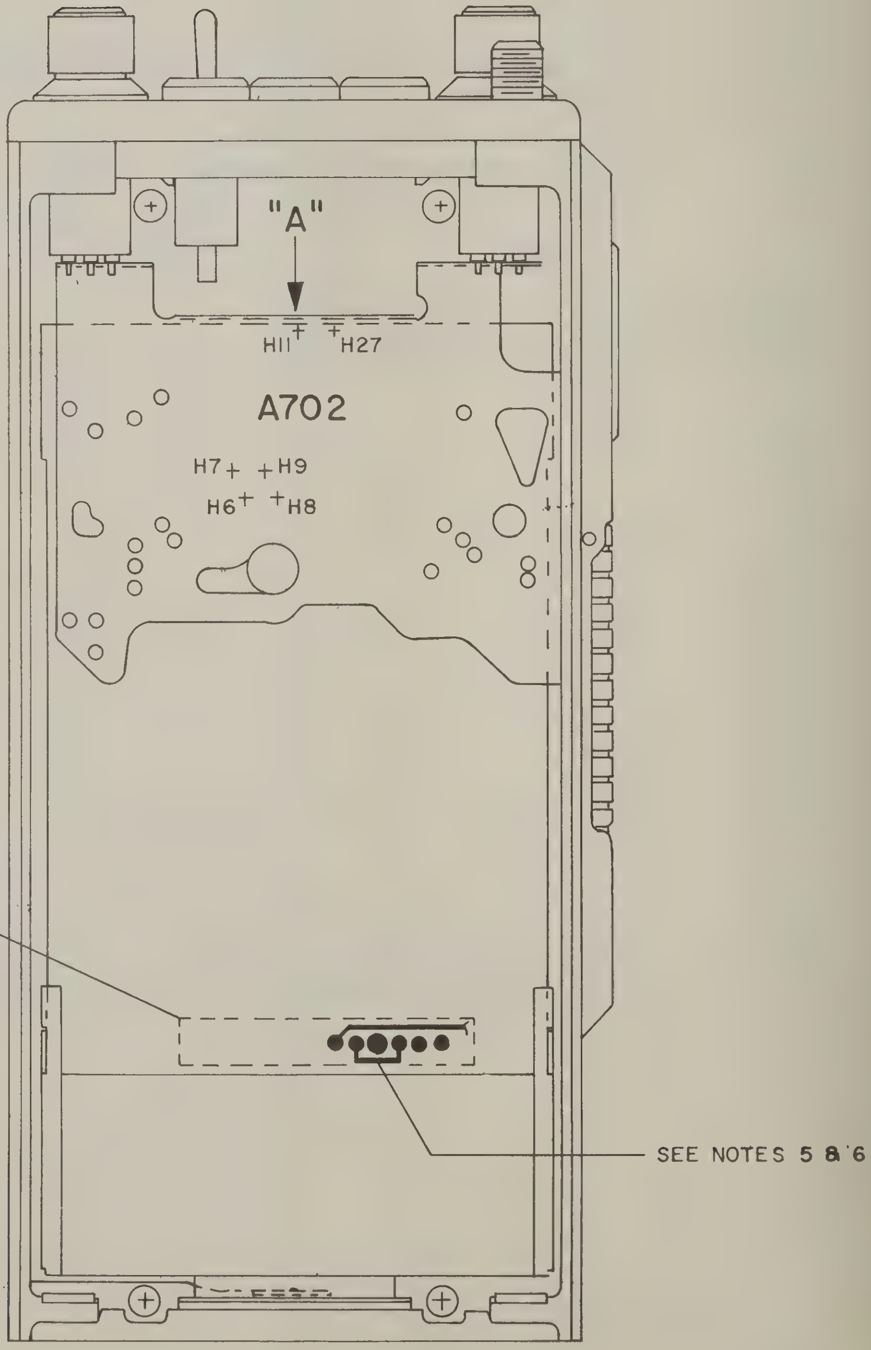
Issue 1


H17
H28
H3
H13
H20
H23
H4
H2
H5
H1
H29
H14
H16
H25
H24
H15
H18
H10
H19
H12

VIEW AT "A"


SEAL
19B232508P1
MODULE
NUT
19A127319P6
S1001
1
2
3
KEYWAY

YPICAL SWITCH MOUNTING

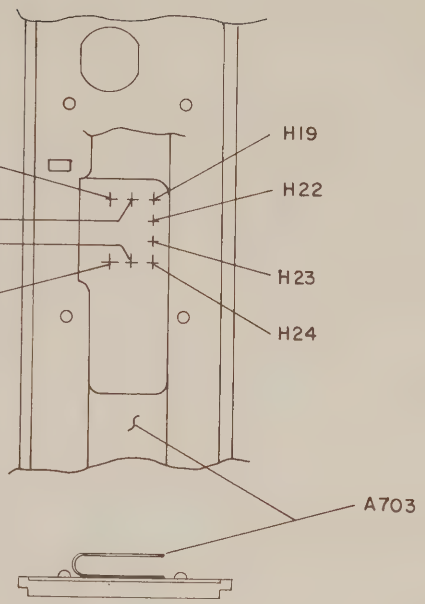

"A"
H11
H27
A702
H7
H9
H6
H8
CG
(CHANNEL GUARD)
PL19D429618G1
SEE NOTES 5 & 6

(19D429867, Sh. 5, Rev. 1)

CH

SYMBOL	GE PART NO.
S1001	19A116648P6
	19D429521P1
	19B232996G3
	19A127319P6
	19B232508P1
	19B219681P1
	19D429618G1
	NP280529

*COMPONENTS ADDED, DI



HOLE IDENT A703

THESE INSTRUCTIONS COVER THE INSTALLATION OF HARDWARE KIT PL19A137835G2 FOR APPLICATION OF CHANNEL GUARD (CG) PL19D429618G1 ENC/DEC IN THE B & C CASE WITH A DELUXE SYSTEM CONTROLLER. THE CG TO BE AUTO-MONITOR BY THE FREQ. SELECT SWITCH AND WITH A MANUAL MONITOR SWITCH

1. SAME AS INSTRUCTIONS 1 - 11 FOR PART 3 OR PART 4 PLUS THE INSTRUCTIONS BELOW.
2. MAKE CONNECTIONS FROM CHART BELOW:

FROM	TO	WIRE
A703-H21	S1001-3	T28 W-R

3. OPTION 3 OF THE DELUXE CONTROLLER IS USED TO ACCOMPLISH THIS FUNCTION. THE CONTROLLER WILL BE PROGRAMED ON INSTRUCTIONS 19A138064 PER CUSTOMERS ORDER.

INSTALLATION INSTRUCTIONS

Sheet 6

THESE INSTRUCTIONS COVER THE INSTALLATION OF HARDWARE KIT PL19A137835G2 FOR APPLICATION OF CHANNEL GUARD (CG) PL19D429618G1 ENC/DEC IN THE "B OR C" CASE MPR WITH MANUAL MONITOR.

* 1. REMOVE KNOBS, TOP COVER, FRONT AND BACK COVERS AND DUMMY BLOCK IF PRESENT.

2. PUNCH OUT HOLE IN TOP PLATE AT POSITION SHOWN.

3. INSTALL S1001 SWITCH IN POSITION SHOWN.

4. CONNECT SWITCH TO FLEX CIRCUIT FROM CHART BELOW:

FROM	TO	WIRE
A702-H1	S1001-3	T28 W-R
A702-H2	S1001-2	T28 BK

5. FOR STANDARD OPERATION CUT RUN ON SOLDER SIDE OF SYSTEM BOARD BETWEEN PIN 3 AND PIN 5 OF CG AS SHOWN. (THIS ALLOWS THE UNIT TO TX ENC WITH CG SWITCH OFF).

6. IF IT IS DESIRABLE TO TURN CG OFF, THAT IS, WITH THE CG SWITCH OFF THE UNIT WILL MONITOR ON RX AND DOES NOT TX ENC ON TX THEN OMIT STEP 5.

7. SOLDER ALL ELECTRICAL CONNECTIONS.

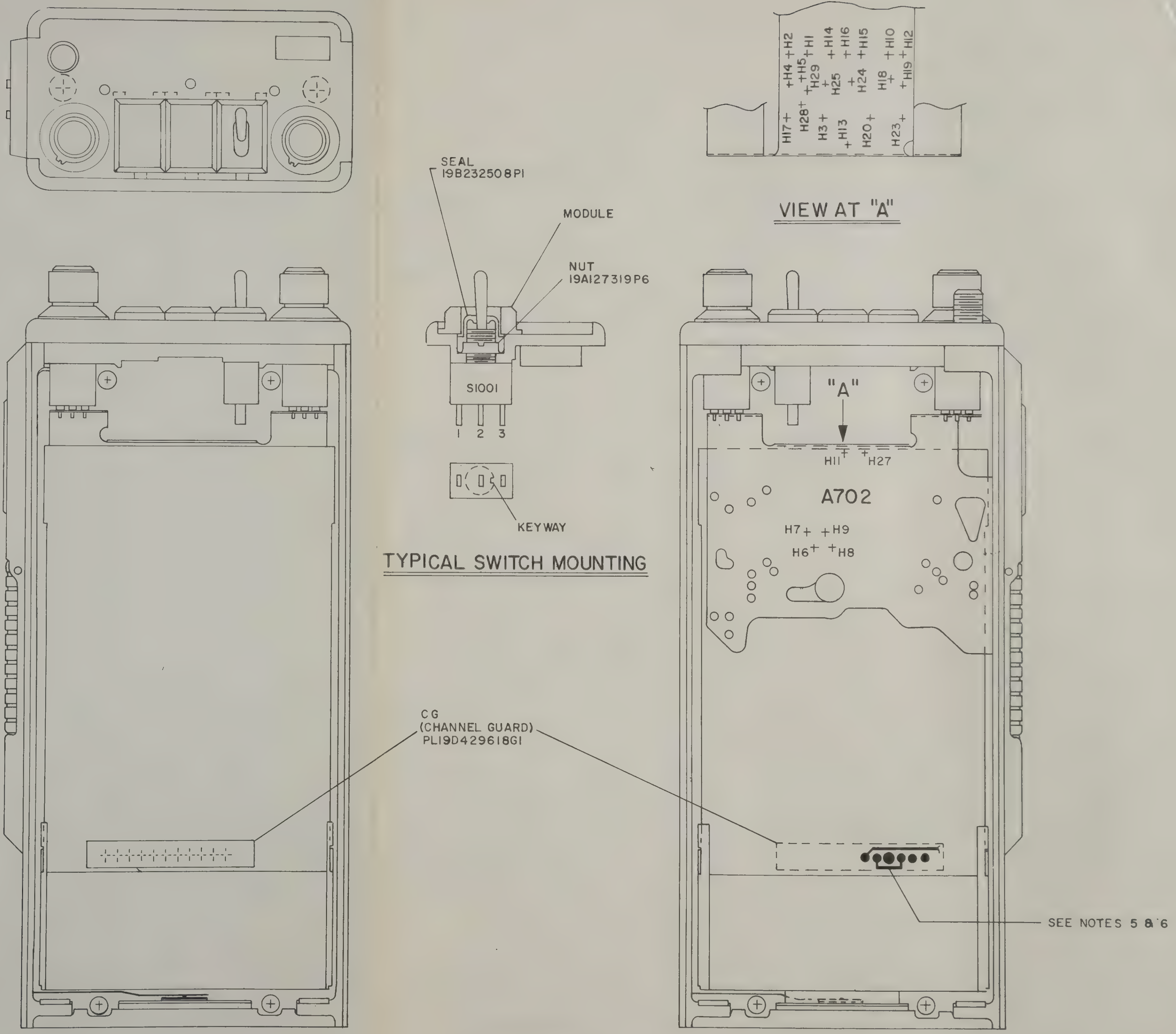
8. USE INSTRUCTIONS ON SHEET 3 FOR FREQ CODING CG.

9. PLUG IN CG MODULE IN POSITION SHOWN.

10. ASSEMBLE SEAL OVER S1001 AND REPLACE BLANK MODULE WITH THE CHANNEL GUARD MODULE.

11. IF ALL OTHER OPTIONS THAT REQUIRE REMOVAL OF THE TOP COVER HAVE BEEN INSTALLED, SNAP ON TOP COVER AND INSTALL KNOBS AND FRONT AND BACK COVERS.

* REQUIRED IN FIELD INSTALLATION.


H4 H2 H5 H1 H29 H28 H14 H16 H15 H10 H12
H17 H3 H25 H24 H8 H19 H13 H20 H23
SEAL
19B232508P1
MODULE
NUT
19A127319P6
S1001
1 2 3
KEYWAY
"A"
H11 H27
A702
H7 H9
H6 H8
CG
(CHANNEL GUARD)
PL19D429618G1
SEE NOTES 5 & 6

VIEW AT "A"

TYPICAL SWITCH MOUNTING

INSTALLATION INSTRUCTIONS

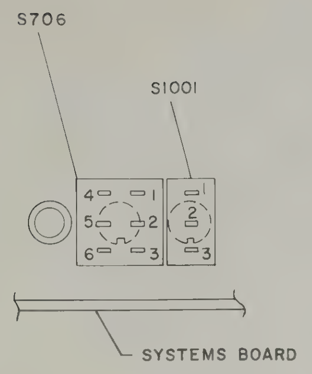
Sheet 5

PARTS LIST

CHANNEL GUARD ENCODE/DECODE
HARDWARE KIT
19A137835G1 ENCODE
19A137835G2 ENCODE/DECODE
ISSUE 1

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - - SWITCHES - - - - - - - - - - -
S1001	19A116648P6	Toggle: SPDT; sim to C & K Components 7101SDG.
		- - - - - - - - - - - MISCELLANEOUS - - - - - - -
	19D429521P1	Cover.
	19B232996G3	Decorative cap. (Used with S1001).
	19A127319P6	Nut: 1/4-40. (Secures S1001).
	19B232508P1	Seal. (Used with S1001).
	19B219681P1	Contact, electrical. (Located on Channel Guard module).
		ASSOCIATED PARTS
	19D429618G1	Channel Guard Encode/Decode Module.
	NP280529	Nameplate. (CG FREQ).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES



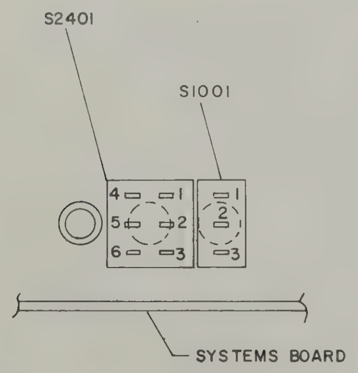
TERMINAL IDENT S706, S1001

THESE INSTRUCTIONS COVER THE INSTALLATION OF HARDWARE KIT PL19A137835G2 FOR APPLICATION OF CHANNEL GUARD (CG) PL19D429618G1 ENC/DEC IN THE "A" CASE AND "B" CASE WITH THE FREQ SELECTED BY A TOGGLE SWITCH. THE CG TO BE AUTO-MONITOR BY THE FREQ SELECT SWITCH AND WITH A MUAL MONITOR SWITCH.

1. SAME AS INSTRUCTIONS 1 - 11 FOR PART 3 OR PART 4 PLUS THE INSTRUCTIONS BELOW

1. INTERCONNECT THE FREQ SWITCH WITH THE CG MANUAL MONITOR SWITCH USING THE CHART BELOW:

FROM	TO	WIRE	REMARKS
S706-2	S706-5	DM	
S706-4	S1001-3	T28 W-R	CG ON CHANNEL 2
S706-6	S1001-3	T28 W-R	CG ON CHANNEL 1



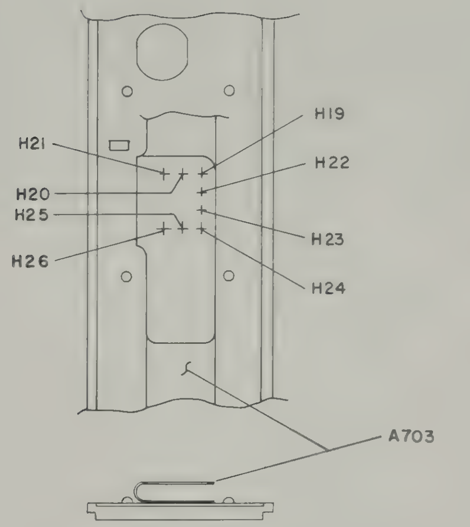
TERMINAL IDENT S2401, S1001

THESE INSTRUCTIONS COVER THE INSTALLATION OF HARDWARE KIT PL19A137835G2 FOR APPLICATION OF CHANNEL GUARD (CG) PL19D429618G1 ENC/DEC IN THE "A" AND "B" CASE WITH THE FREQ. SELECTED BY A TOGGLE SWITCH AND THE SAME SWITCH CONTROLS THE PSLM OR SLM. THE CG TO BE AUTO-MONITOR BY THE SAME SWITCH AND ALSO WITH A MANUAL MONITOR SWITCH.

1. SAME AS INSTRUCTIONS 1 - 11 FOR PART 3 OR PART 4 PLUS THE INSTRUCTION BELOW.

2. INTERCONNECT THE FREQ SWITCH S2401 WITH THE CG MANUAL MONITOR SWITCH USING THE CHART BELOW:

FROM	TO	WIRE	REMARKS
S2401-3	S1001-3	T28 W-R	CG ON CHANNEL 2
S2401-4	S1001-3	T28 W-R	CG ON CHANNEL 1



HOLE IDENT A703

THESE INSTRUCTIONS COVER THE INSTALLATION OF HARDWARE KIT PL19A137835G2 FOR APPLICATION OF CHANNEL GUARD (CG) PL19D429618G1 ENC/DEC IN THE B & C CASE WITH A DELUXE SYSTEM CONTROLLER. THE CG TO BE AUTO-MONITOR BY THE FREQ. SELECT SWITCH AND WITH A MANUAL MONITOR SWITCH

1. SAME AS INSTRUCTIONS 1 - 11 FOR PART 3 OR PART 4 PLUS THE INSTRUCTIONS BELOW.

2. MAKE CONNECTIONS FROM CHART BELOW:

FROM	TO	WIRE
A703-H21	S1001-3	T28 W-R

3. OPTION 3 OF THE DELUXE CONTROLLER IS USED TO ACCOMPLISH THIS FUNCTION. THE CONTROLLER WILL BE PROGRAMED ON INSTRUCTIONS 19A138064 PER CUSTOMERS ORDER.

INSTALLATION INSTRUCTIONS

Sheet 6

MOBILE RADIO

MPR *Personal Series*

RAPID ONE DESK CHARGER COMBINATION 351L4A1X

Maintenance Manual LBI30780A

DESK CHARGER 351L4A1X

SPECIFICATIONS *

Combination No.	Input Voltage	AC Input Current	AC Input Power
351L4A1X	121 VAC (50/60 Hz)	245 Milliamps	24 Watts
351M4A1X	240 VAC (50/60 Hz)	165 Milliamps	24 Watts

Used with MPR Personal Series two-way FM radios.

TYPICAL CHARGING CURRENT	1.2 amperes
RECHARGE TIME	1 hour
TEMPERATURE RANGE	+5°C to 45°C (+41°F to 113°F)

---

*These specifications are intended primarily for the use of the serviceman. Refer to the appropriate Specification Sheet for the complete specifications.

GENERAL ELECTRIC

MOBILE RADIO

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RAPID ONE DESK CHARGER COMBINATION 351L4A1X

Maintenance Manual LBI30780A

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GENERAL ELECTRIC

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COMBINATION NOMENCLATURE

1st Digit	2nd Digit	3rd Digit	4th Digit	5th Digit	6th Digit	7th Digit	8th Digit
PRODUCT LINE	APPLICATION	PACKAGE	INPUT VOLTAGE	CHARGE TIME	VERSION	TYPE	Frequency Range
3 Charger	**5** MPR (700 mAh and 1200 mAh Batt)	**1** DESK	**L** 121 VAC	**4** 1-hour	**A** 1-Charge Socket	**A** 1-Charge Socket	**X** Not Range Sensitive
			M 240 VAC				

WARNING

No one should be permitted to handle any portion of the equipment that is supplied with high voltage; or to connect any external apparatus to the units while the units are supplied with power. KEEP AWAY FROM LIVE CIRCUITS.

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DESCRIPTION

General Electric one hour desk charger combination 351L4A1X will recharge 700 mAh or 1200 mAh battery packs, used with the MPR Personal series, two-way FM radios. A fully discharged 1200 mAh battery pack will charge back to a full charge in one hour. A fully discharge 700 mAh battery pack will charge back to a full charge in less than one hour.

When a battery pack is inserted into the charging insert of the desk charger, an amber LED indicator labeled "CHARGING", will light, indicating the battery pack is being charged. When the battery pack is fully charged, a green LED indicator labeled "READY" will light and the charger will automatically switch to a safe trickle charge rate.

The desk charger uses heat sensors to constantly monitor the temperature of both the battery pack and the charging insert. When a cold battery pack is inserted into the charging insert, the charger will wait until the battery pack has warmed up to within approximately 10°C of ambient. The charger will then, automatically, apply a fast charge rate. When the battery pack overcharges enough to heat the cells 10°C above ambient, or if the battery pack voltages reaches 9.15 volts, the charger will switch from fast charge to trickle charge. The charger also has a memory, set when the charger switches from the fast charge rate to trickle charge and reset by removing the battery pack from the charging insert or an AC power failure. If a hot battery is in the charging insert and the memory has not been reset, the charger will remain at the trickle charge rate. If the memory has been reset, the charger will wait until the battery pack has cooled before automatically switching to fast charge. If a fully charged battery pack is removed from the charging insert and then re-inserted, it will charge until the cells reheat or the voltage reaches 9.15 volts.

INSTALLATION

The desk charger can be located on a table top or other flat surface. The location should be close to the appropriate power source.

CAUTION

The desk charger should not be used in a hazardous location.

OPERATION

Temperature characteristics of nickel-cadmium batteries, prevent a full charge at temperature extremes. For a maximum charge, recharge the battery pack at room temperatures of from 65° to 85° Fahrenheit whenever possible.

WARNING

General Electric Charger combinations covered in this manual, are designed for charging GE 700 mAh battery pack 19D429763G1 and GE 1200 mAh battery pack 19D429777G1. Charging any other battery pack or batteries may result in damage to equipment, leakage or explosion.

To use the desk charger, plug the power cable into an applicable 50/60 Hz source (See Figure 1). Place the radio into the charging insert with the speaker facing the front of the charger, or place the battery pack into the insert with the arrow on the yellow label pointing toward the rear of the charger. The amber LED indicator labeled "CHARGING" will light, indicating the battery is being charged. To charge the battery to 100% capacity, let the 1200 mAh battery pack charge for at least one hour. Let the 700 mAh battery pack charge for one hour or until the "READY" indicator is on.

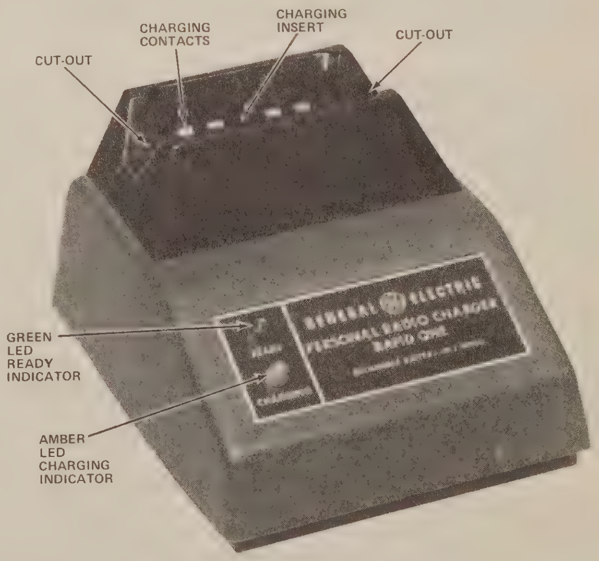


Figure 1 - Desk Charger

A battery pack is removed from the charger by simply reaching into the cut outs provided in the sides of the charging insert, and lifting the battery pack out.

CAUTION

The radio is not usable while being charged in the charger, and it is recommended that the unit be turned off prior to charge.

CIRCUIT ANALYSIS

The Rapid-1 desk charger consists of a power supply, charging circuit, temperature controlled cut-off circuit, voltage cut-off circuit and current control circuit. The power supply is a full wave rectifier circuit with an unfiltered output. The unfiltered output of the power supply causes the charging current to flow through silicon controlled rectifier Q801, in the charging circuit, at 100 to 120 Hz/second.

Temperature Cut-Off

The temperature controlled cut-off circuit consists of thick film hybrid integrated circuit U1. U1 monitors the temperature of both the charging insert, through thermistor RT801, and the battery pack through a thermistor inside the battery pack. U1 also turns the "READY" indicator on when the battery pack is fully charged and provides memory to prevent the same battery pack from being recharged at the fast rate.

Thermistors RT801 and RT Battery are connected with R21 and R22 to form a bridge circuit (See Figure 2). The outputs of the bridge circuit are connected to terminals 2 and 14 of U1. When a battery pack is in the charging insert and U1 senses the bridge to be in a balanced condition, the fast rate of charge is enabled. When the battery pack is removed from the charging insert RT Battery is removed from the bridge circuit causing the bridge to be unbalanced. U1 sensing the bridge circuit to be unbalanced, the voltage on U1-14 being much larger than the voltage on U1-2, turns off the charger and resets the charger memory.

When the battery pack temperature is more than 10°C below ambient, thermistor RT Battery is a high resistance and the voltage on U1-14 is larger than the voltage on U1-2 just as though no battery pack were present. SCR Q801 and LED "READY" indicator DS802 remain off. The battery pack charges at a trickle charge rate, until it is less than 10°C below ambient. At less than 10°C below ambient, the voltage at U1-14 is higher than the voltage at U1-2 causing the charger to switch to the fast charge rate.

Voltage Cut-Off and Current Control

The voltage cut-off and current control circuits consist of operational amplifiers AR1-1, 2 and 3. Operational Amplifier AR1-1 compares a reference voltage on the negative (-) input to the battery voltage on the positive (+) input. The battery voltage is applied to the positive input through voltage divider circuit CR6, R21 and R22. When the battery voltage exceeds 9.15V the output of AR1-1, applied to U1-9, cuts off the charger.

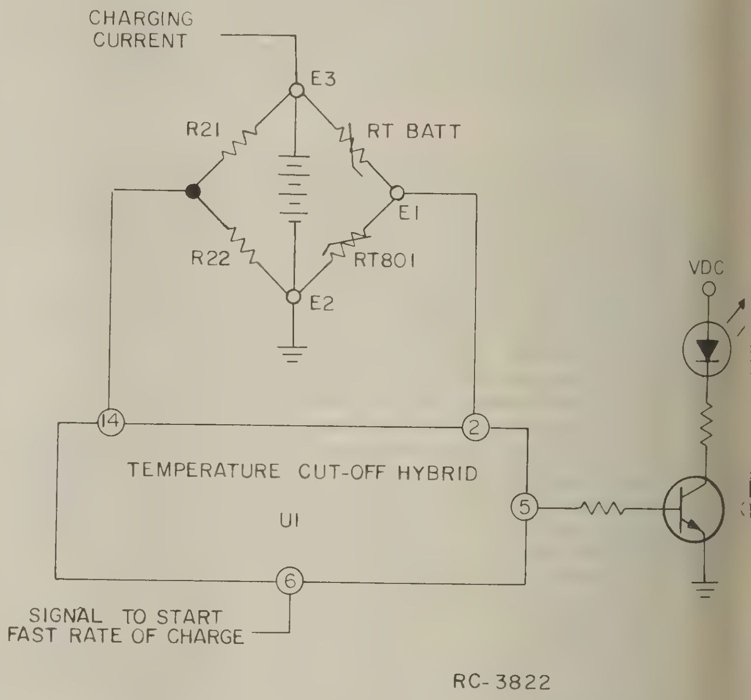
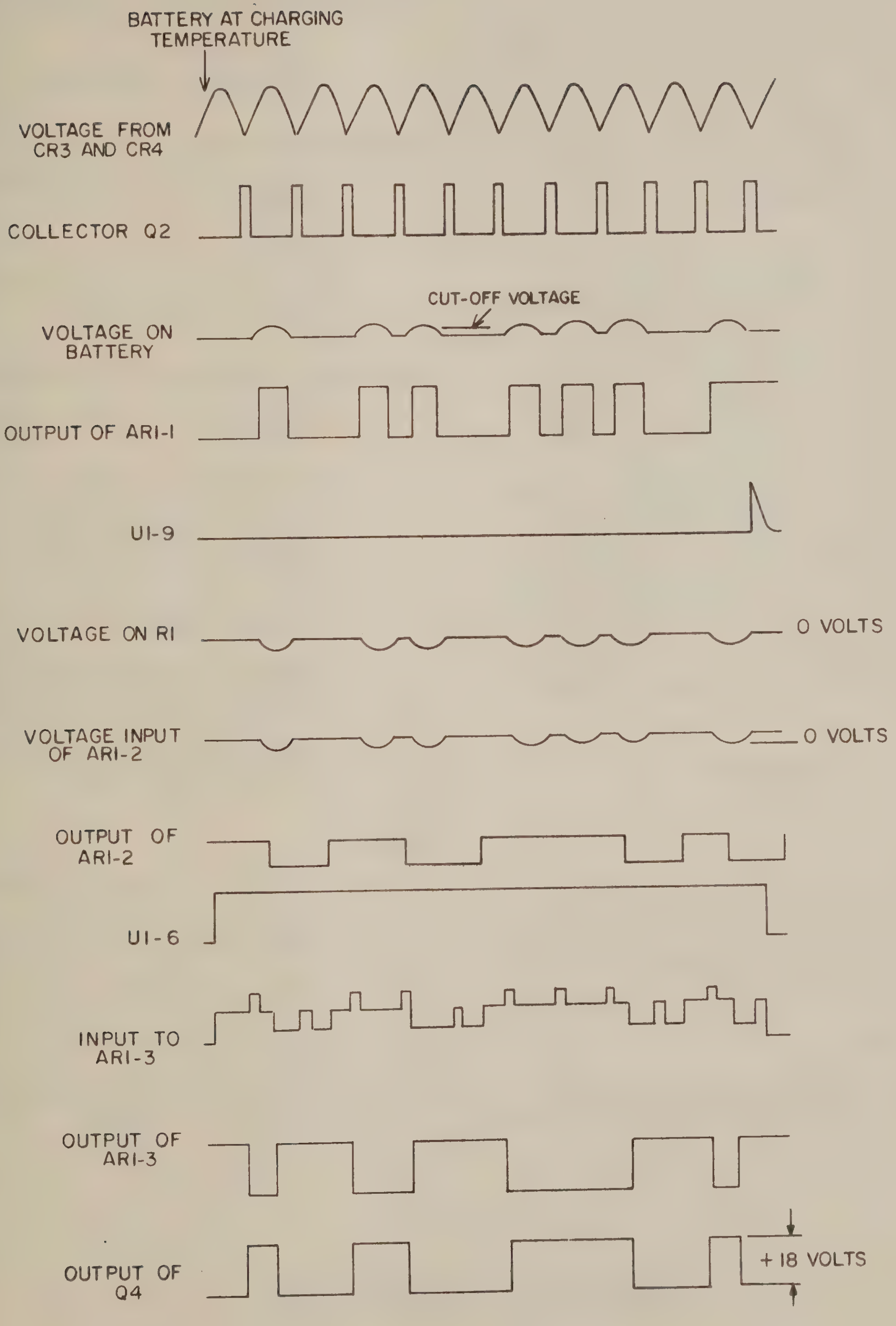

CHARGING CURRENT
E3
R21
RT BATT
E1
R22
RT801
E2
VDC
14
2
TEMPERATURE CUT-OFF HYBRID
U1
5
6
SIGNAL TO START FAST RATE OF CHARGE
RC-3822

Figure 2 - Simplified Temperature Cut-Off Circuitry

The output of AR1-1 is applied to U1-9 only during the time there is no high rate of charge (See Figure 3). This time is determined by a 1 millisecond sampling pulse on the collector of transistor Q2. This sampling pulse occurs only when the voltage from the fullwave rectifier is almost 0 volts.

Operational amplifier AR1-2 compares a reference current, on the negative (-) input, to the charge current delivered to the battery pack on the positive (+) input. This comparison determines if the battery pack need more current or less current to maintain a 1200 milliamp charge rate. The output of AR1-2 is applied to the input of operational amplifier AR1-3.

Operational amplifier AR1-3 fires SCR 801. The negative (-) input of AR1-3 is an AND input of the 1 millisecond sample pulse


BATTERY AT CHARGING TEMPERATURE
VOLTAGE FROM CR3 AND CR4
COLLECTOR Q2
CUT-OFF VOLTAGE
VOLTAGE ON BATTERY
OUTPUT OF AR1-1
U1-9
VOLTAGE ON R1
0 VOLTS
VOLTAGE INPUT OF AR1-2
0 VOLTS
OUTPUT OF AR1-2
U1-6
INPUT TO AR1-3
OUTPUT OF AR1-3
OUTPUT OF Q4
+ 18 VOLTS

RC-3823

Figure 3 - Timing Chart

from Q2, the positive output of AR1-2 and the positive output of U1-6. All three conditions must be present to start the fast charge rate. Two must be present to sustain the fast charge rate. The positive input from U2-6 indicates "the battery pack is ok to charge". The positive input from AR1-2 indicates "The battery pack needs more current", and the positive 1 millisecond pulse input from Q2 provides the timing. The three positive conditions on the negative (-) input of AR1-3 causes a negative pulse on the output of AR1-3.

The negative pulse on the output of AR1-3 cuases transistor Q3 to produce a +18 volt pulse to fire SCR Q801 and start the fast charge. As the battery pack temperature increases 10°C above ambient during overcharge, the voltage at U1-2 becomes larger than the voltage at U1-14 causing U1-6 to go low. U1-6 going low pulls and holds the input to the negative (-) terminal of AR1-3 lower than the input on the positive (+) terminal. The output of AR1-3 causes Q3 to stop conducting, removing the +18 volt gating signal from Q801. Q801 shuts off, switching from the fast charge rate to the trickle charge rate. The larger voltage on U1-2 also causes U1-5 to go high. The high output on U1-5 causes transistor Q4 to conduct and DS802 to light. A memory circuit inside of U1 is set so that the same battery pack cannot be recharged at the high charge rate unless it is first removed from the charging insert to reset the memory.

MAINTENANCE

DISASSEMBLY

To gain access to the desk charger circuitry for servicing, remove the three Phillips-head screws in the bottom of the charger and carefully lift off the housing. The charger must be disassembled to replace the LED indicators and fuse.

TROUBLESHOOTING

Should a difficult service problem arise, the Troubleshooting Procedure listed in the Table of Contents is provided to assist the serviceman. Also, voltages are provided on the schematic diagram to further assist the serviceman to isolate any problem.

ADJUSTMENT PROCEDURE

EQUIPMENT REQUIRED

1. General Electric Test Calibrator 4EX20A10.
2. Voltmeter
3. Clip on DC Milliammeter HP Model 428B or equivalent.

PRELIMINARY CONNECTION AND ADJUSTMENTS

1. Set I ADJ, R5, fully counter-clockwise.
2. Set VCO ADJ, R3, fully clockwise.
3. Connect milliammeter to red wire between P802-3 and E3 on the charging insert.
4. Insert calibrator 4EX20A10 into charging insert.
5. Connect voltmeter to calibrator 4EX20A10 and set voltage adjust on the calibrator for 9.15 volts.
6. Set temperature switch on Test Calibrator for NORMAL.

PROCEDURE

1. Adjust I ADJ, R5, for 1 amp.
2. Slowly adjust VCO ADJ, R3, CCW until the high rate of charge stops.
3. Adjust calibrator for 8.7 volts.
4. Press the reset button for 1 second and release.
5. Adjust I ADJ, R5, until charge current is 1.2 amps.

GENERAL ELECTRIC COMPANY• MOBILE COMMUNICATIONS DIVISION
WORLD HEADQUARTERS• LYNCHBURG, VIRGINIA 24502 U.S.A.

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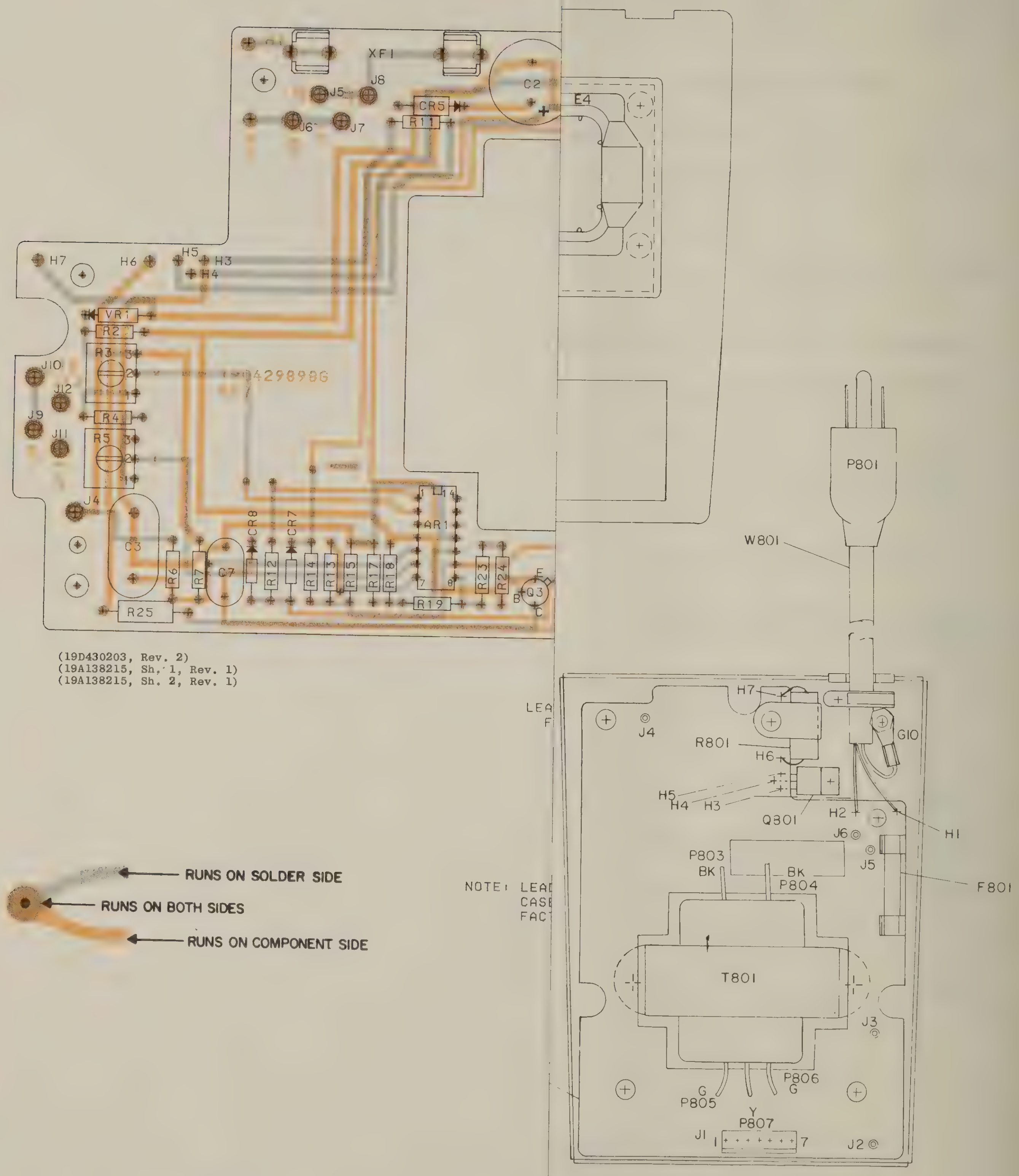
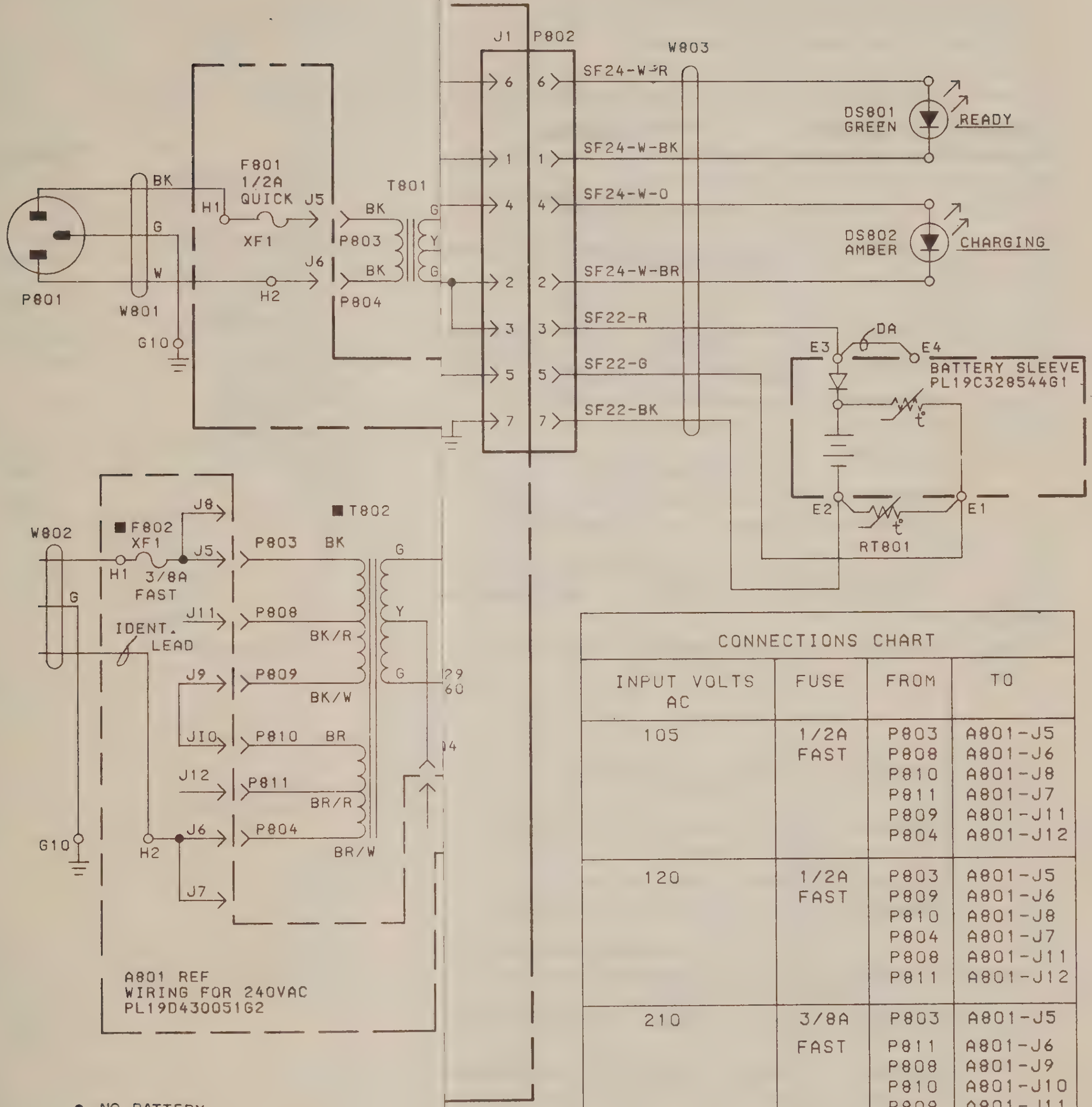

XF1
J8
J5
J6
J7
C2
CR5
R11
E4
H7
H6
H5
H3
H4
VR1
R2
R3
J10
J12
J9
J11
R4
R5
19D429898G
J4
C3
R6
R7
C7
CR8
CR7
R12
R14
R13
R15
R17
R18
AR1
R23
R24
Q3
E
B
C
R19
R25
RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE
P801
W801
LEA
F
NOTE: LEAD
CASE
FACT
H7
J4
R801
G10
H6
H5
H4
H3
Q801
H2
H1
J6
J5
P803
BK
BK
P804
F801
T801
J3
G
P805
P806
G
Y
P807
J1
1
7
J2

(19D430203, Rev. 2)
(19A138215, Sh. 1, Rev. 1)
(19A138215, Sh. 2, Rev. 1)

VIEW AT 'H'

OUTLINE DIAGRAM

1 - HOUR CHARGER COMBINATION
351L4A1X


J1
P802
W803
SF24-W-R
DS801
GREEN
READY
SF24-W-BK
SF24-W-O
DS802
AMBER
CHARGING
SF24-W-BR
SF22-R
SF22-G
SF22-BK
DA
E3
E4
BATTERY SLEEVE
PL19C328544G1
E2
E1
RT801
F801
1/2A
QUICK
J5
T801
BK
G
Y
H1
XF1
P803
J6
P804
H2
P801
W801
G10
W
G10
■ T802
W802
■ F802
XF1
J8
J5
P803
H1
3/8A
FAST
IDENT.
LEAD
J11
P808
BK/R
J9
P809
BK/W
J10
P810
BR
J12
P811
BR/R
J6
P804
BR/W
J7
H2
A801 REF
WIRING FOR 240VAC
PL19D430051G2
6
1
4
2
3
5
7

● NO BATTERY

■ BATTERY CHARGING

▲ BATTERY HOT
(HOT CHARGING)

READINGS TAKEN USING
TEST CALIBRATOR 4EX20A10

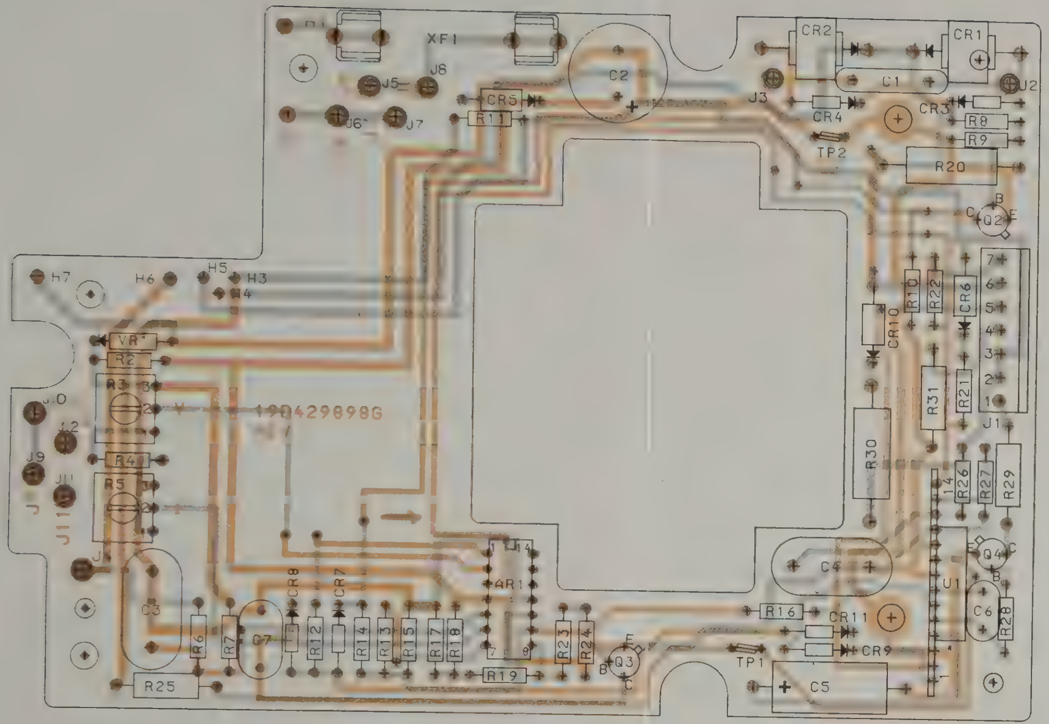
BATTERY VOLTAGE SET FOR
8.7 VDC USING FLUKE 8120A DVM

CONNECTIONS CHART

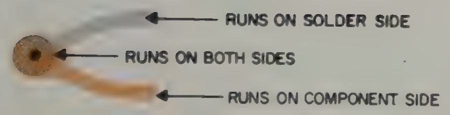
INPUT VOLTS AC	FUSE	FROM	TO
105	1/2A FAST	P803	A801-J5
		P808	A801-J6
		P810	A801-J8
		P811	A801-J7
		P809	A801-J11
		P804	A801-J12
120	1/2A FAST	P803	A801-J5
		P809	A801-J6
		P810	A801-J8
		P804	A801-J7
		P808	A801-J11
		P811	A801-J12
210	3/8A FAST	P803	A801-J5
		P811	A801-J6
		P808	A801-J9
		P810	A801-J10
		P809	A801-J11
		P804	A801-J12
240	3/8A FAST	P803	A801-J5
		P808	A801-J11
		P809	A801-J9
		P810	A801-J10
		P811	A801-J12
		P804	A801-J6

SCHEMATIC DIAGRAM

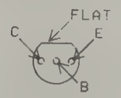
1 - HOUR CHARGER COMBINATION
351L4A1X


XF1
CR2
CR1
C2
C1
J2
J3
J5
J6
J7
J8
CR5
R11
CR4
CR3
R8
R9
TP2
R20
Q2
H7
H6
H5
H3
H4
VR1
R2
R3
R4
R5
19D429898G
CR10
R10
R22
CR6
R31
R21
R30
J1
R26
R27
R29
C4
Q4
U1
C6
R28
C3
AR1
R16
CR11
CR9
TP1
C5
Q3
R6
R7
C7
CR8
CR7
R12
R14
R13
R15
R17
R18
R19
R23
R24
R25

(19D430203, Rev. 2)
(19A138215, Sh. 1, Rev. 1)
(19A138215, Sh. 2, Rev. 1)

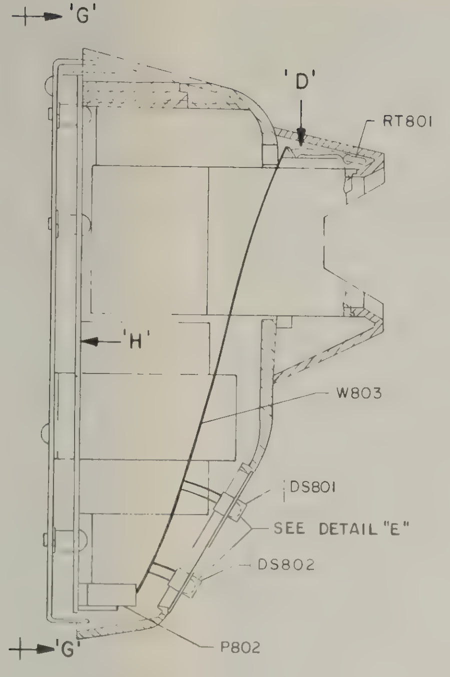

RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE

LEAD IDENTIFICATION
FOR Q2,Q3,& Q4.

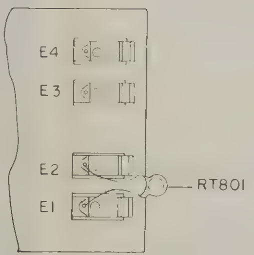


IN-LINE
TOP VIEW

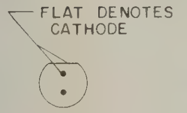
NOTE: LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

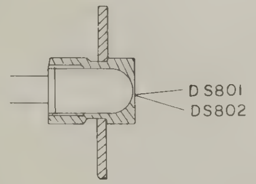

'G'
'D'
RT801
'H'
W803
DS801
SEE DETAIL "E"
DS802
'G'
P802

SECTION 'F-F'


E4
E3
E2
E1
RT801

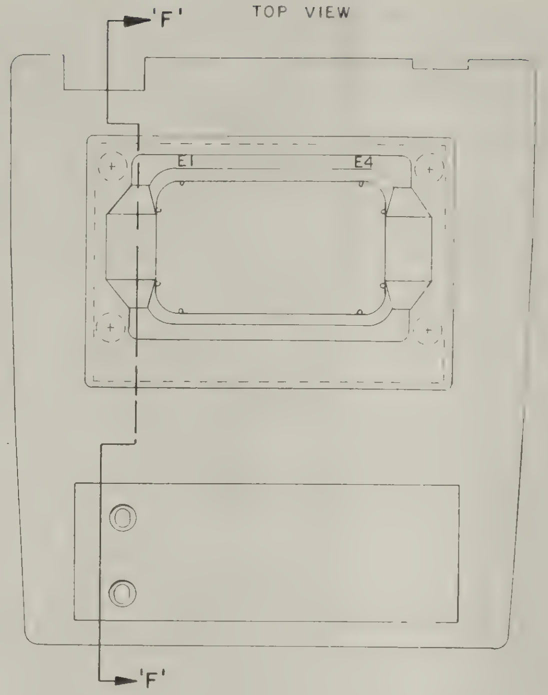
VIEW AT 'D'

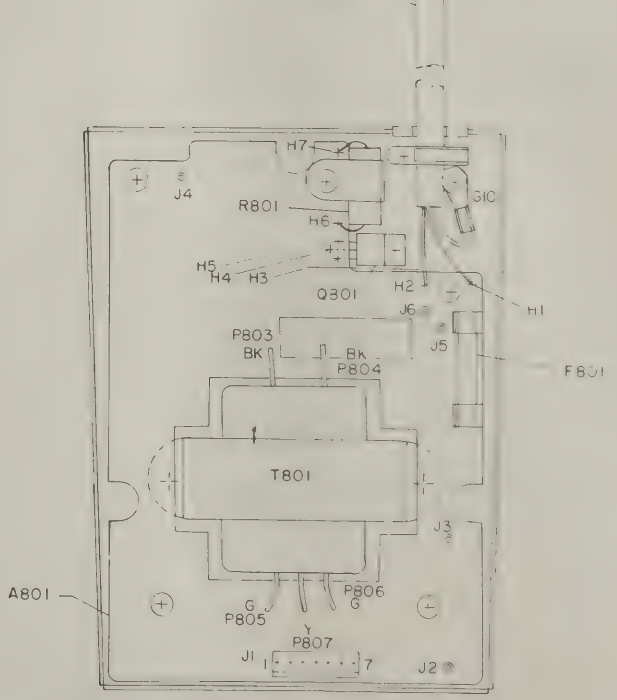

FLAT DENOTES CATHODE


DS801
DS802

DETAIL 'E'

TOP VIEW



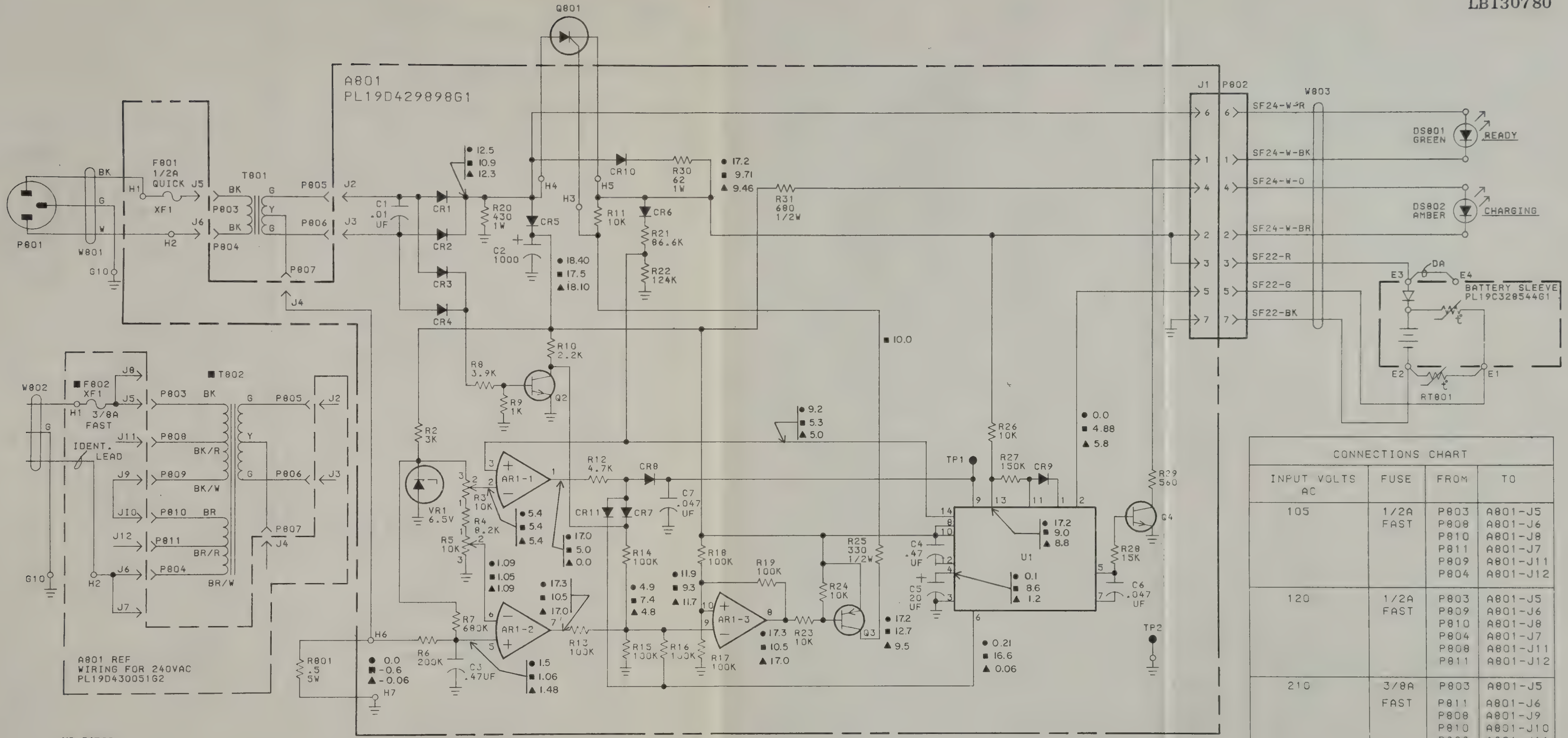

W801
P801
H7
J4
R801
H6
SIC
H5
H4
H3
Q801
H2
J6
H1
P803
BK
BK
P804
J5
F801
T801
J3
A801
G
P805
P806
G
Y
P807
J1
1
7
J2

VIEW AT 'H'

(19D430391, Rev. 0)

OUTLINE DIAGRAM

1 - HOUR CHARGER COMBINATION
351L4A1X


Q801
A801
PL19D429898G1
P801
BK
G
W
W801
G10
H1
F801
1/2A
QUICK
XF1
J5
J6
H2
T801
P803
P804
BK
Y
G
P805
P806
P807
J2
J3
J4
C1
.01
UF
CR1
CR2
CR3
CR4
R20
430
1W
C2
1000
CR5
H4
H3
H5
CR10
R30
62
1W
R11
10K
CR6
R21
86.6K
R22
124K
R31
680
1/2W
● 12.5
■ 10.9
▲ 12.3
● 17.2
■ 9.71
▲ 9.46
● 18.40
■ 17.5
▲ 18.10
R10
2.2K
R8
3.9K
R9
1K
Q2
■ 10.0
J1
P802
W803
SF24-W-R
SF24-W-BK
SF24-W-O
SF24-W-BR
SF22-R
SF22-G
SF22-BK
DS801
GREEN
READY
DS802
AMBER
CHARGING
E3
DA
E4
BATTERY SLEEVE
PL19C328544G1
E2
E1
RT801
W802
■ F802
XF1
3/8A
FAST
IDENT.
LEAD
J8
J11
J9
J10
J12
J7
■ T802
P808
P809
P810
P811
BK/R
BK/W
BR
BR/R
BR/W
A801 REF
WIRING FOR 240VAC
PL19D430051G2
R2
3K
VR1
6.5V
R3
10K
R4
8.2K
R5
10K
AR1-1
● 5.4
■ 5.4
▲ 5.4
● 17.0
■ 5.0
▲ 0.0
● 1.09
■ 1.05
▲ 1.09
● 17.3
■ 10.5
▲ 17.0
R7
680K
AR1-2
R6
200K
C3
.47UF
R13
100K
H6
H7
R801
.5
5W
● 0.0
■ -0.6
▲ -0.06
● 1.5
■ 1.06
▲ 1.48
R12
4.7K
CR8
C7
.047
UF
CR11
CR7
R14
100K
R15
100K
R16
100K
● 4.9
■ 7.4
▲ 4.8
● 11.9
■ 9.3
▲ 11.7
R18
100K
R19
100K
R17
100K
AR1-3
● 17.3
■ 10.5
▲ 17.0
R23
10K
R24
10K
Q3
R25
330
1/2W
● 17.2
■ 12.7
▲ 9.5
● 9.2
■ 5.3
▲ 5.0
C4
.47
UF
C5
20
UF
U1
TP1
R26
10K
R27
150K
CR9
● 0.0
■ 4.88
▲ 5.8
● 17.2
■ 9.0
▲ 8.8
● 0.1
■ 8.6
▲ 1.2
● 0.21
■ 16.6
▲ 0.06
R29
560
Q4
R28
15K
C6
.047
UF
TP2

● NO BATTERY

■ BATTERY CHARGING

▲ BATTERY HOT
(HOT CHARGING)

READINGS TAKEN USING
TEST CALIBRATOR 4EX20A10

BATTERY VOLTAGE SET FOR
8.7 VDC USING FLUKE 8120A DVM

ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF=MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH=MILLIHENRYS OR H=HENRYS.

MODEL NO	REV LETTER
PL19D429898G1 PL19D430051G1 PL19D430051G2	

PWR AND GND CONN

DEVICE	V+5V PIN NO	GND PIN NO
AR1	4	11

■ SEE CHART FOR CHANGES REQUIRED FOR DIFFERENT INPUT VOLTAGES

NOTES:
1. TERMINATE WIRES AT P802 WITH 19A116781P3.

CONNECTIONS CHART

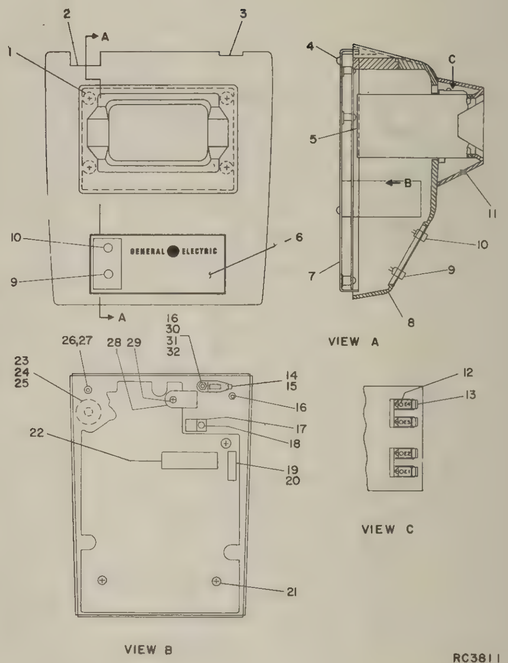
INPUT VOLTS AC	FUSE	FROM	TO
105	1/2A FAST	P803 P808 P810 P811 P809 P804	A801-J5 A801-J6 A801-J8 A801-J7 A801-J11 A801-J12
120	1/2A FAST	P803 P809 P810 P804 P808 P811	A801-J5 A801-J6 A801-J8 A801-J7 A801-J11 A801-J12
210	3/8A FAST	P803 P811 P808 P810 P809 P804	A801-J5 A801-J6 A801-J9 A801-J10 A801-J11 A801-J12
240	3/8A FAST	P803 P808 P809 P810 P811 P804	A801-J5 A801-J11 A801-J9 A801-J10 A801-J12 A801-J6

SCHEMATIC DIAGRAM

1 - HOUR CHARGER COMBINATION
351L4A1X

(RC-3816A)
(19D430070, Rev. 8)

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - - TRANSFORMERS - - - - - - - -
T801	19A134177P3	Power, step-down: Pri: 121 VRMS, 50/60 Hz, Sec: 1500 VRMS, 60 Hz.
T802	19A134177P5	Power, step-down: Pri: 105/120/210/240 VRMS, 50/60 Hz, Sec: 1500 VRMS, 60 Hz.
		- - - - - - - - - - - - CABLES - - - - - - - - - -
W801	19B232987G1	Power: 3 conductors, approx 6 feet long.
W802	19B232987G3	Power: 2 poles, 3 conductors, approx 6 feet long.
W803	19D430051G3	Desk Charger. (Includes DS801, DS802, & P802).
		MECHANICAL PARTS (SEE RC3811)
1	19A116773P108	Tap screw, Phillips POZIDRIV®: No. 7-19 x 1/2.
2	19C317175P3	Plug.
3	19B227249P1	Grommet.
4	19A116773P106	Tap screw, Phillips POZIDRIV®: No. 7-19 x 3/8.
5	19C328544G1	Sleeve assembly. (Includes items 12 & 13).
6	NP280658	Nameplate. (GENERAL ELECTRIC).
7	19C328910G1	Base assembly. (Includes items 23-27, & 32).
8	19E500894P3	Housing.
9	19A134521P3	Lens.
10	19A134521P2	Lens.
11	19D429698P1	Collar.
12	N136P503C	Tap screw, phillips head: No. 2-32 x 3/16.
13	19C327044P1	Contact, spring.
14	19A115185P4	Strap buckle: sim to Panduit Corp. TA-1.
15	19A115185P2	Strap: sim to Thomas & Betts TY-525M.
16	7141225P3	Hex nut: No. 6-32.
17	19A116023P1	Insulator, plate.
18	19A134016P1	Insulator, bushing.
19	19A116688P1	Clip, electrical. (XF1 - Quantity 2).
20	19A130456G1	Fuse cover.
21	N80P13005C6	Machine screw, phillips: No. 6-32 x 5/16.
22	NP279917P11	Nameplate. (Fuse rating).
23	19A134365P1	Bumper, rubber.
24	19A134366P1	Rivet, tubular.
25	N402P37C6	Flatwasher, steel: No. 6.
26	19A143578P213	Spacer, threaded, metallic: No. 6-32.
27	N404P19C13	Lockwasher, internal tooth: No. 10. (Not Used).
28	19A138023P1	Clip. (Secures R801).
29	N80P13007C6	Machine screw, phillips: No. 6-32 x 7/16. (Secures R801).
30	N404P13C6	Lockwasher, internal tooth: No. 6.
31	N402P7C6	Flatwasher, narrow: No. 6.
32	4037460P6	Stud, self clinching.



RC3811

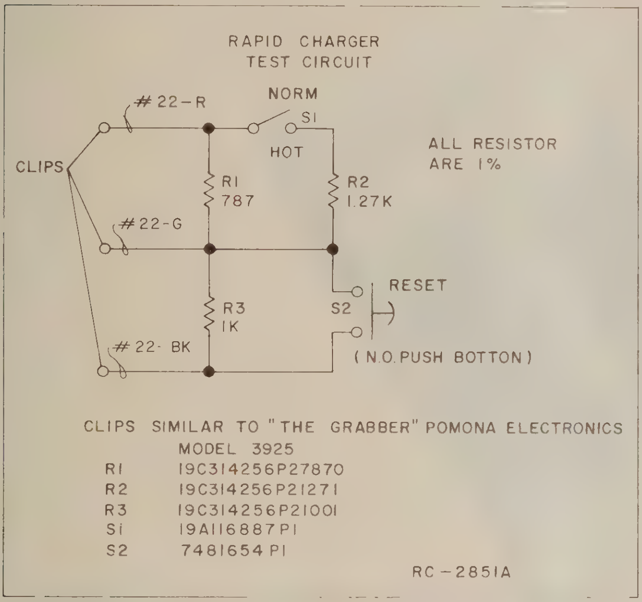
The test circuit shown can be used to simulate battery pack conditions and determine if the charger is working properly. Switch S1 simulates battery pack temperature (open-room temperature, closed-hot battery pack). Switch S2 resets charger logic, the same as removing the battery pack from the charging insert.

Connect the test circuit as shown on the diagram. Insert a battery pack into the charging insert. Use the logic chart and voltage readings on the diagram to determine the working condition of the charger.

If the charger works properly with the test circuit, but not with the battery pack, check thermistors RT1 and RT Battery. Each should measure approximately 50K ohms at room temperature (25°C).

Other Checks:

1. If a known good battery pack has been charging and the charger fails to shut-off (READY light does not come on) at the end of the charge time, check Q801 and Q4.
2. U1-11 always high, logic will not reset, check C4.
3. U1-6 always low, no high rate of charge, check C5.
4. U1-5 always low, logic will not reset, check C6.
5. No high rate of charge, check for open CR9.
6. Charger cuts off when battery pack is inserted, check Q2.


RAPID CHARGER
TEST CIRCUIT
#22-R
NORM
S1
HOT
CLIPS
R1
787
R2
1.27K
#22-G
R3
1K
S2
RESET
#22- BK
(N.O. PUSH BOTTON)
ALL RESISTOR
ARE 1%

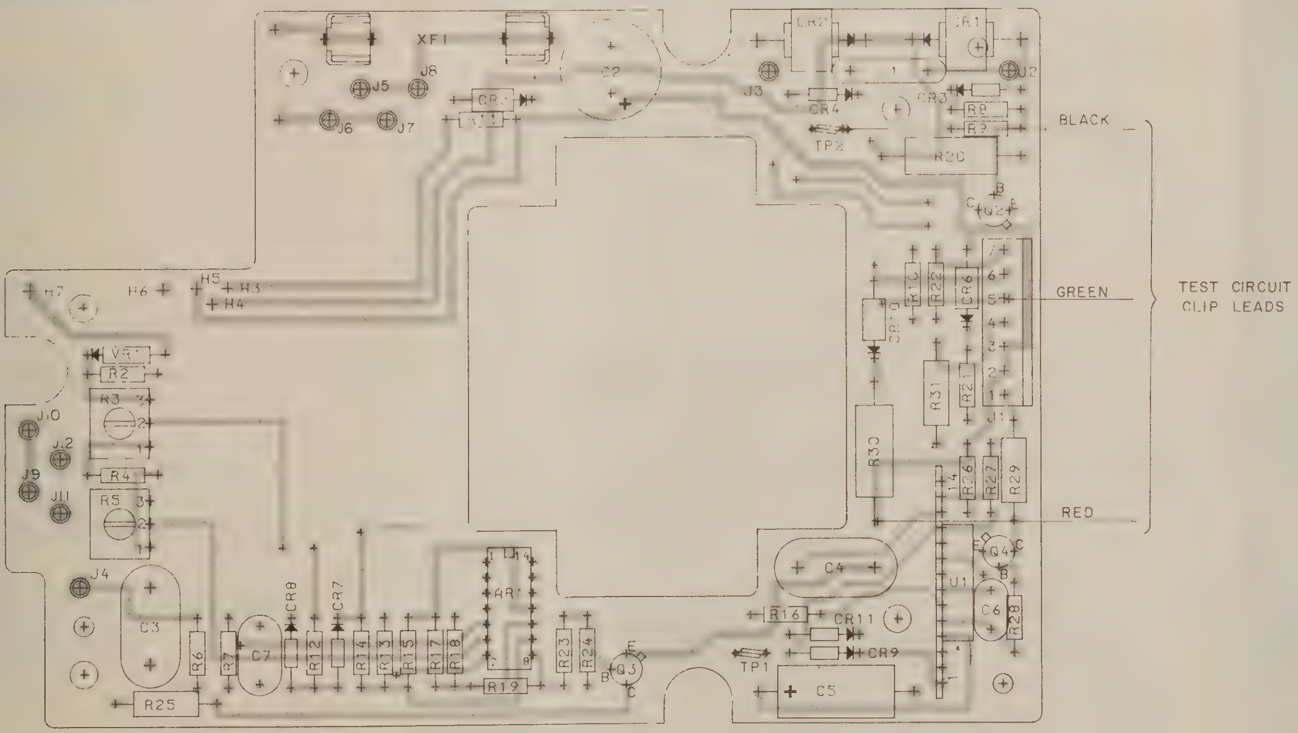
CLIPS SIMILAR TO "THE GRABBER" POMONA ELECTRONICS
MODEL 3925

R1	19C314256P27870
R2	19C314256P21271
R3	19C314256P21001
S1	19A116887P1
S2	7481654 P1

RC-2851A

Test Battery Condition	UI Pin				Test CKT Switch Position	
	11	4	6	5	S1	S2
No Battery	High	Low	Low	Low	Norm	Closed
Cold Battery	High	Low	Low	Low	Norm	Closed
Normal Battery Charging	Low	High	High	Low	Norm	Open
Charged Battery	Low	Low	Low	High	Hot	Open
Hot Battery Just Inserted	Low	Low	Low	Low	Hot	Open

Low = Pin Voltage 1.0 Volts
High = Pin Voltage 3.0 Volts


XF1
C2
J5
J6
J6
J7
CR5
R11
CR2
CR1
J3
J2
CR4
CR3
R8
R9
TP2
R20
BLACK
Q2
B
C
E
H7
H6
H5
H3
H4
R10
R22
CR6
CR10
7
6
5
4
3
2
1
J1
GREEN
TEST CIRCUIT
CLIP LEADS
VR1
R2
R3
R4
R5
J10
J12
J9
J11
R31
R21
R30
R26
R27
R29
14
RED
Q4
C4
U1
C6
R28
J4
C3
CR8
CR7
AR1
R16
CR11
CR9
TP1
R6
R7
C7
R12
R14
R13
R15
R17
R18
R23
R24
Q3
R19
R25
C5

(RC-3825)
(19D430205, Rev. 2)
(19A138215, Sh. 2, Rev. 1)

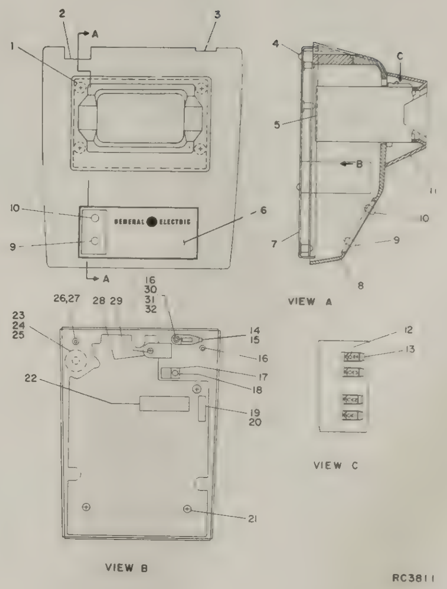
TROUBLESHOOTING PROCEDURE

RAPID - 1 DESK CHARGER
351L4A1X

PARTS LIST

MPR 1 HOUR DESK CHARGER
351L4A1X 19D430051G1
351M4A1X 19D430051G2
(RAPID - 1)

SYMBOL	GE PART NO.	DESCRIPTION
A801		COMPONENT BOARD 19D429898G1
AR1	19A134511P1	Integrated circuit, linear: Quad OP AMP; sim to NSLCM 224N or MLM 224P.
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	7774750P13	Ceramic disc: 0.01 µf +100% -0%, 500 VDCW.
C2	19A134679P1	Electrolytic: 1000 µf +75 -10%, 25 VDCW; sim to Sprague Type 502D108G025ET1B.
C3 and C4	19A116080P111	Polyester: 0.47 µf ±10%, 50 VDCW.
C5	19A115680P3	Electrolytic: 20 µf +150% -10%, 25 VDCW; sim to Mallory Type TTX.
C6	19A116080P105	Polyester: 0.047 µf ±10%, 50 VDCW.
C7	19A116080P105	Polyester: 0.047 µf ±10%, 50 VDCW.
		- - - - - - - DIODES AND RECTIFIERS - - - - - - -
CR1 and CR2	19A116783P1	Silicon, rectifier: 100 VDC blocking, 6 amps.
CR3 and CR4	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
CR5 and CR6	4037822P1	Silicon, 1000 mA, 400 PIV.
CR7 thru CR9	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
CR10	4037822P1	Silicon, 1000 mA, 400 PIV.
CR11	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
		- - - - - - - JACKS AND RECEPTACLES - - - - - - -
J1	19A116659P106	Connector, printed wiring: 7 contacts; sim to Molex 09-60-1071.
J2 thru J6	4033513P4	Contact, electrical: sim to Bead Chain L93-3.
J7 thru J12	4033513P4	Contact, electrical: sim to Bead Chain L93-3.
		- - - - - - - - - TRANSISTORS - - - - - - - - -
Q2	19A115910P1	Silicon, NPN; sim to Type 2N3904.
Q3	19A115852P1	Silicon, PNP; sim to Type 2N3906.
Q4	19A115910P1	Silicon, NPN; sim to Type 2N3904.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R2	3R152P302J	Composition: 3K ohms ±5%, 1/4 w.
R3	19A116559P106	Variable, cermet: 10K ohms ±20%, .5 w; sim to CTS Series 360.
R4	19A700106P85	Composition: 8.2K ohms ±5%, 1/4 w.
R5	19A116559P106	Variable, cermet: 10K ohms ±20%, .5 w; sim to CTS Series 360.
R6	3R152P204J	Composition: 200K ohms ±5%, 1/4 w.
R7	3R152P684J	Composition: 680K ohms ±5%, 1/4 w.
R8	19A700106P77	Composition: 3.9K ohms ±5%, 1/4 w.
R9	19A700106P63	Composition: 1K ohms ±5%, 1/4 w.
R10	19A700106P71	Composition: 2.2K ohms ±5%, 1/4 w.
R11	19A700106P87	Composition: 10K ohms ±5%, 1/4 w.
R12	19A700106P79	Composition: 4.7K ohms ±5%, 1/4 w.
R13 thru R19	19C314256P21003	Metal film: 100K ohms ±1%, 1/4 w.
R20	3R78P431J	Composition: 430 ohms ±5%, 1 w.
R21	19C314256P28662	Metal film: 86.6K ohms ±1%, 1/4 w.
R22	19C314256P21243	Metal film: 124K ohms ±1%, 1/4 w.
R23 and R24	19A700106P87	Composition: 10K ohms ±5%, 1/4 w.
R25	19A700106P51	Composition: 330 ohms ±5%, 1/2 w.
R26	19A700106P87	Composition: 10K ohms ±5%, 1/4 w.
R27	3R152P154J	Composition: 150K ohms ±5%, 1/4 w.
R28	19A700106P91	Composition: 15K ohms ±5%, 1/4 w.
R29	19A700113P57	Composition: 560 ohms ±5%, 1/2 w.
R30	3R78P620J	Composition: 62 ohms ±5%, 1 w.
R31	19A700113P59	Composition: 680 ohms ±5%, 1/2 w.
		- - - - - - - - - TEST POINTS - - - - - - - - -
TP1 and TP2	19B211379P1	Spring (Test Point).
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - -
U1	19D423164G1	Temp. Hybrid Coil.
		- - - - - - - VOLTAGE REGULATORS - - - - - - - -
VR1	4036887P6	Zener: 500 mW, 6.5 v. nominal.
		- - - - - - - - - - SOCKETS - - - - - - - - - -
XF1	19A116688P1	Clip, electrical. (Quantity 2).
		- - - - - - - - - - - DIODES - - - - - - - - - - -
DS801	19A134354P3	Diode, optoelectronic: green; sim to HEW. Packard 5082-4955.
DS802	19A134354P2	Diode, optoelectronic: yellow; sim to HEW. Packard 5082-4555.
		- - - - - - - - - - - FUSES - - - - - - - - - - -
F801	1R16P1	Quick blowing: 1/2 amp at 250 v; sim to Littelfuse 312.500 or Bussmann AGC-1/2.
F802	1R16P14	Quick blowing: 3/8 amp at 250 v; sim to Littelfuse 312.375 or Bussmann AGC-3/8.
		- - - - - - - - - - - PLUGS - - - - - - - - - - -
P801		(Part of W801).
P802	19A116659P82	Connector, printed wiring: 7 contacts; sim to Molex 09-50-7071.
P803 thru P811	4029840P1	Contact, electrical: sim to AMP 41854.
		- - - - - - - - - - TRANSISTORS - - - - - - - - -
Q801	19A116451P1	Thyristor, rectifier, silicon controlled: sim to C122BX3.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R801	5493035P65	Wirewound: 0.5 ohms ±10%, 5 w; sim to Hamilton Hall Type HR.
RT801	19C300048P6	Resistor, thermistor: 50K ohms ±10%; sim to NL Ind. 4D103.
		- - - - - - - - - - TRANSFORMERS - - - - - - - -
T801	19A134177P3	Power, step-down: Pri: 121 VRMS, 50/60 Hz, Sec: 1500 VRMS, 60 Hz.
T802	19A134177P5	Power, step-down: Pri: 105/120/210/240 VRMS, 50/60 Hz, Sec: 1500 VRMS, 60 Hz.
		- - - - - - - - - - - CABLES - - - - - - - - - -
W801	19B232987G1	Power: 3 conductors, approx 6 feet long.
W802	19B232987G3	Power: 2 poles, 3 conductors, approx 6 feet long.
W803	19D430051G3	Desk Charger. (Includes DS801, DS802, & P802).
		MECHANICAL PARTS (SEE RC3811)
1	19A116773P108	Tap screw, Phillips POZIDRIV®: No. 7-19 x 1/2.
2	19C317175P3	Plug.
3	19B227249P1	Grommet.
4	19A116773P106	Tap screw, Phillips POZIDRIV®: No. 7-19 x 3/8.
5	19C328544G1	Sleeve assembly. (Includes items 12 & 13).
6	NP280658	Nameplate. (GENERAL ELECTRIC).
7	19C328910G1	Base assembly. (Includes items 23-27, & 32).
8	19E500894P3	Housing.
9	19A134521P3	Lens.
10	19A134521P2	Lens.
11	19D429698P1	Collar.
12	N136P503C	Tap screw, phillips head: No. 2-32 x 3/16.
13	19C327044P1	Contact, spring.
14	19A115185P4	Strap buckle: sim to Panduit Corp. TA-1.
15	19A115185P2	Strap: sim to Thomas & Betts TY-525M.
16	7141225P3	Hex nut: No. 6-32.
17	19A116023P1	Insulator, plate.
18	19A134016P1	Insulator, bushing.
19	19A116688P1	Clip, electrical. (XF1 - Quantity 2).
20	19A130456G1	Fuse cover.
21	N80P13005C6	Machine screw, phillips: No. 6-32 x 5/16.
22	NP279917P11	Nameplate. (Fuse rating).
23	19A134365P1	Bumper, rubber.
24	19A134366P1	Rivet, tubular.
25	N402P37C6	Flatwasher, steel: No. 6.
26	19A143578P213	Spacer, threaded, metallic: No. 6-32.
27	N404P19C13	Lockwasher, internal tooth: No. 10. (Not Used).
28	19A138023P1	Clip. (Secures R801).
29	N80P13007C6	Machine screw, phillips: No. 6-32 x 7/16. (Secures R801).
30	N404P13C6	Lockwasher, internal tooth: No. 6.
31	N402P7C6	Flatwasher, narrow: No. 6.
32	4037460P6	Stud, self clinching.



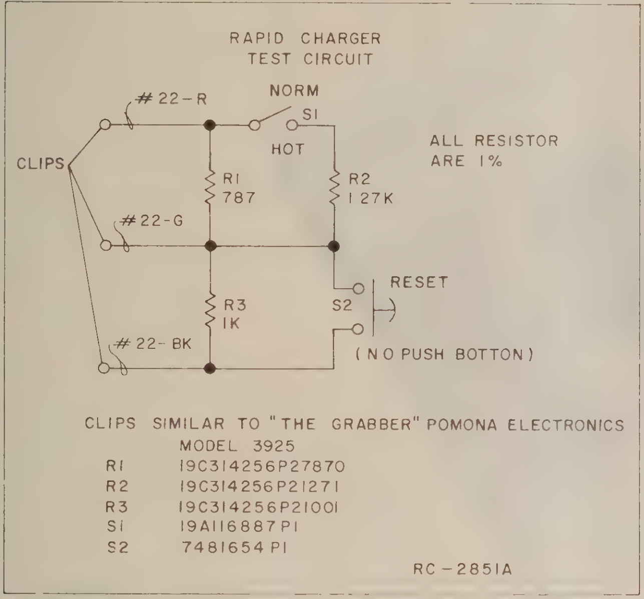
The test circuit shown can be used to simulate battery pack conditions and determine if the charger is working properly. Switch S1 simulates battery pack temperature (open-room temperature, closed-hot battery pack). Switch S2 resets charger logic, the same as removing the battery pack from the charging insert.

Connect the test circuit as shown on the diagram. Insert a battery pack into the charging insert. Use the logic chart and voltage readings on the diagram to determine the working condition of the charger.

If the charger works properly with the test circuit, but not with the battery pack, check thermistors RT1 and RT Battery. Each should measure approximately 50K ohms at room temperature (25°C).

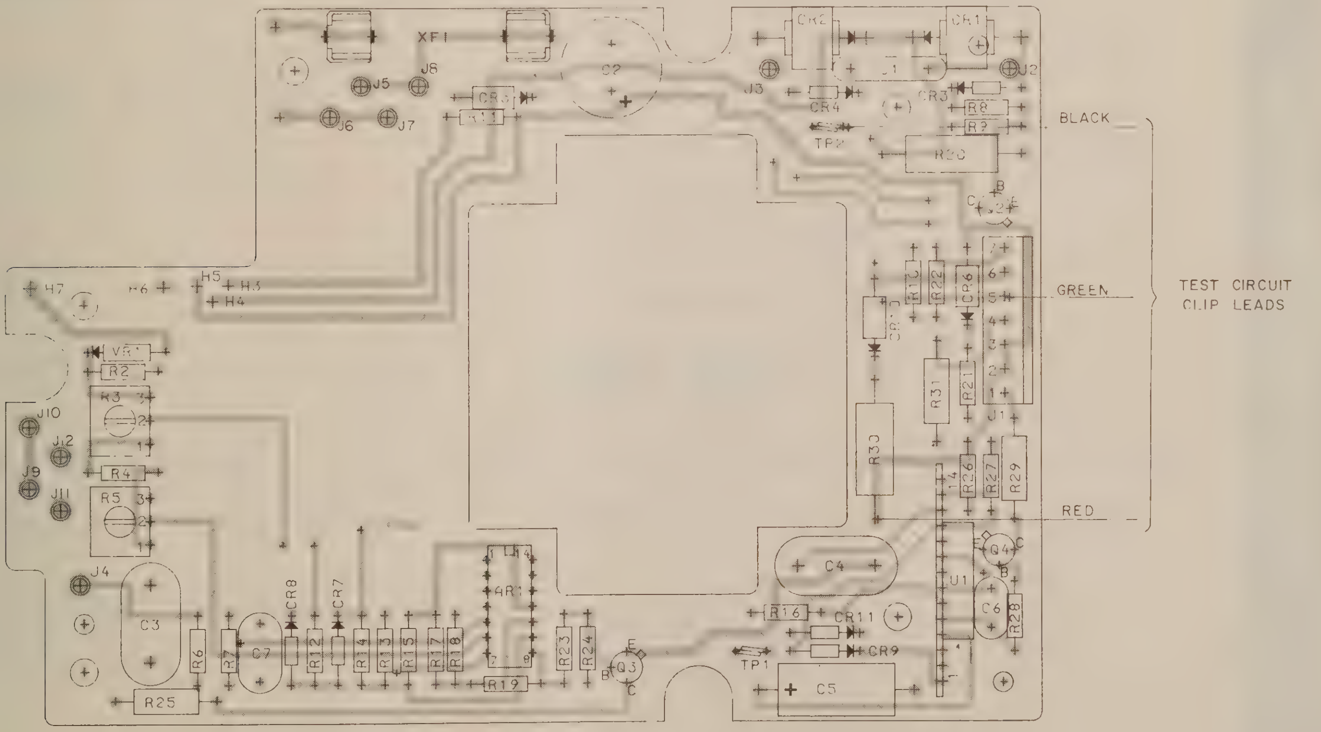
Other Checks:

1. If a known good battery pack has been charging and the charger fails to shut-off (READY light does not come on) at the end of the charge time, check Q801 and Q4.
2. U1-11 always high, logic will not reset, check C4.
3. U1-6 always low, no high rate of charge, check C5.
4. U1-5 always low, logic will not reset, check C6.
5. No high rate of charge, check for open CR9.
6. Charger cuts off when battery pack is inserted, check Q2.


RAPID CHARGER
TEST CIRCUIT
#22-R
NORM
S1
HOT
CLIPS
R1
787
R2
127K
#22-G
R3
1K
S2
RESET
#22-BK
(NO PUSH BOTTON)
ALL RESISTOR
ARE 1%
CLIPS SIMILAR TO "THE GRABBER" POMONA ELECTRONICS
MODEL 3925
R1 19C314256P27870
R2 19C314256P21271
R3 19C314256P21001
S1 19A116887P1
S2 7481654P1
RC-2851A

Test Battery Condition	UI Pin				Test CKT Switch Position	
	11	4	6	5	S1	S2
No Battery	High	Low	Low	Low	Norm	Closed
Cold Battery	High	Low	Low	Low	Norm	Closed
Normal Battery Charging	Low	High	High	Low	Norm	Open
Charged Battery	Low	Low	Low	High	Hot	Open
Hot Battery Just Inserted	Low	Low	Low	Low	Hot	Open

Low = Pin Voltage 1.0 Volts
High = Pin Voltage 3.0 Volts


XF1
CR2
CR1
J8
J5
J6
J7
C2
CR5
J3
CR4
CR3
U2
R8
R9
TP2
R20
BLACK
C2
H7
R6
H5
H3
H4
R17
R22
CR6
7
6
5
4
3
2
1
GREEN
TEST CIRCUIT
CLIP LEADS
VR1
R2
R3
R31
R21
J1
J10
J12
J9
J11
R4
R5
R30
R26
R27
R29
RED
14
Q4
E
B
C
J4
C4
AR1
U1
C6
C3
CR8
CR7
R16
CR11
R28
R6
R7
C7
R12
R14
R13
R15
R17
R18
R23
R24
Q3
CR9
TP1
R25
R19
C5

(RC-3825)
(19D430205, Rev. 2)
(19A138215, Sh. 2, Rev. 1)

TROUBLESHOOTING PROCEDURE

RAPID - 1 DESK CHARGER
351L4A1X

MOBILE RADIO

MPR Personal Series

RAPID I MULTI-CHARGER COMBINATIONS

Maintenance Manual LBI30862
DATAFILE FOLDER - DF0077

1 HOUR MULTI-CHARGER COMBINATIONS

GENERAL ELECTRIC
RAPID ONE

SPECIFICATIONS *

Dimensions (H x W x D)	5.66" x 9.16" x 16.4" (14.4 cm x 23.3 cm x 41.7 cm)
Weight	15 pounds (6.8 Kilograms)
Capacity	6 Charging Inserts
Indicators	Amber CHARGING Green READY
Charge Time (<100%)	≈1 hour (1200 mAh battery pack)
Charging Temperature Range	5°C to 45°C
Typical Charge Current	
High Rate	1200 Milliamps
Trickle Rate	85 Milliamps

hese specifications are intended primarily for the use of the serviceman. Refer to the appropriate Specification Sheet for the complete specifications.

GENERAL ELECTRIC

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COMBINATION NOMENCLATURE

Digit 1	Digit 2	Digit 3	Digit 4	Digit 5	Digit 6	Digit 7	Digit 8
Product Line	Application	Package	Input Voltage	Charge Time	Version	Type	Frequency Range
3 Charger	**5** MPR (750 mAh & 1200 mAh Batt.)	**2** Wall	**L** 121 VAC (50/60 Hz)	**4** 1 Hour	**B** Multi Socket	**1**	**X** Not Frequency Sensitive
			M 240 VAC (50/60 Hz)		**C** Multi Socket With Discharger		

DESCRIPTION

General Electric Rapid 1 Multi-Charger combinations will recharge both 750 mAh and 1200 mAh battery packs used with MPR Personal Series, FM, two-way radios. A fully discharged 1200 mAh battery pack will recharge in 1 hour at a 1200 milliamp charge rate. The 750 mAh battery will also charge at 1200 milliamp charge rate, but will fully recharge in less than one hour.

When a battery pack is inserted into any one of six charging inserts, of the multi-charger, an amber LED indicator labeled "CHARGING", will light, indicating contact has been made and the battery pack is ready to be charged. When the battery pack is fully charged, a green LED indicator labeled "READY", will light and the charging circuit will automatically switch to a safe trickle charge rate.

The multi-charger uses heat sensors to constantly monitor ambient temperature, temperature of cells in the battery pack and temperature of the power transformer. When a battery pack is inserted into a charging insert, and contact is made, the amber LED lights and the trickle charge begins. The charging circuit looks at the ambient temperature, transformer temperature and battery temperature. If the battery is cold, the charger will wait until the battery pack warms up, then automatically apply the high charge rate on a variable duty cycle.

The variable duty cycle reduces the "gassing" risk which occurs when cold cells are charged. The duty cycle varies from 0% charge rate at 0°C to 100% charge rate at 20°C battery pack temperature.

If the battery pack is hot, the charger checks its memory to see if it had ever charged that battery pack. Since the memory had been reset, the charger waits until the battery pack cools down below the trip temperature then automatically begins the high charge rate. The memory is reset by removing the battery pack from the charging insert or a loss of AC power for more than 0.5 seconds. During the high charge rate, when the battery pack overcharges enough to heat the cells to 10°C greater than ambient, the charger chuts off the high charge rate and lights the green LED READY indicator. The memory is also set so the charger will not recharge the battery pack again until the memory has been reset.

If the ambient temperature is outside the rated range (5°C to 45°C) all charging stops until a safe temperature exist.

If the temperature of a battery pack inserted into a charging insert is not within safe limits, it will not be charged, and the green READY indicator will blink until a safe temperature exist. The battery pack will then be treated normally.

A microprocessor controller continuously monitors the transformer temperature and prevents the transformer from overheating by sharing the available current between the battery packs currently being charged.

A multi-charger equipped with a Battery Tester/Discharger option allows a fully charged battery pack to be discharged to 6.0 Volts at a switch selectable rate of 750 milliamps or 1200 milliamps. While being discharged a display module will indicate DC (discharge). On completion of discharge the display indicates percentage of charge from 0 to 99%.

For chargers operating on an AC line frequency of 60 Hz only, minutes rather than percent may be selected as the display unit.

Internal jumpers are present on the circuit board to allow use of the charger at 50 Hz power line frequency.

The display will also indicate CO, if the ambient temperature is cold or "EA" for excessive ambient when the charger refuses to operate in an unsafe environment.

A multi-charger combination consists of a metal cabinet with six charging inserts and a power supply. The base of the cabinet has rubber feet so it can be used as a desk top charger and key hole slots are provided for wall mounting.

OPERATION

Temperature characteristics of nickel-cadmium batteries, prevent a full charge at temperature extremes. For a maximum charge, recharge the battery pack at room temperatures of 65° to 85° Fahrenheit whenever possible.

WARNING

In this Maintenance Manual, General Electric Chargers are designed for charging GE 750 mAh battery pack 19D429763G1 and 1200 mAh battery pack 19D429777G1 only. Charging any other battery pack or batteries may result in damage to equipment, leakage or explosion.

To use the multi-charger, plug the power cable into the applicable AC, 50/60 Hz source (See Figure 1). Place the radio to be recharged into a charging insert with the speaker facing away from the power supply or place the battery pack into the insert with the arrow on the yellow label pointing toward the power supply. The amber LED indicator labeled "CHARGING" will light, indicating the battery is being charged. To charge the battery to maximum capacity, let the battery pack charge for at least one hour or until the "READY" indicator is on.

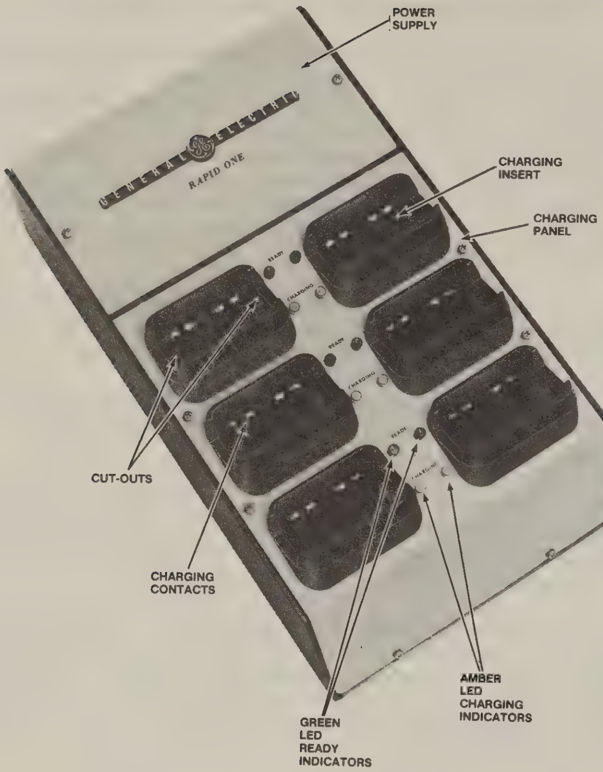


Figure 1 - Multi-Charger

A battery pack is removed from the charger by simply reaching into the cut outs provided in the sides of the charging insert, and lifting the battery pack out.

The radio is not useful while being charged in the charger and it is recommended that the unit be turned off prior to charge.

Battery Discharge Option

To use the battery discharge option, place the DISCHARGE RATE switch, S1, in the correct position corresponding the capacity of the battery pack to be discharged. Connect the charged battery pack to battery pack connector J1. The digital display will read "DC" indicating the discharge has begun. When the discharge is complete, the actual battery pack capacity will be displayed by the digital display as a percentage (0-99%) of the time required to discharge a fully charged battery pack to six Volts.

If the AC line frequency is 60 Hz, internal strapping will permit minutes rather than a percentage to be displayed by the digital display. This time display is the time required to discharge a charged battery pack to six Volts.

SYSTEM ANALYSIS

The hardware of the one hour multi-charger controls charging current for six battery packs and one LED READY indicator, associated with each battery pack. If equipped with a battery discharge option, a seventh battery pack may be discharged to a fixed voltage while the time required for the discharge is recorded and displayed, either as percentage of the time or as actual minutes required to discharge the battery pack from full charge to 6 Volts. Control for the multi-charger hardware is provided by microprocessor U2.

Microprocessor U2 determines the correct and safe charging cycle by multiplexing voltage and temperature data from each battery pack to a single comparator circuit, AR3.

Comparator circuit AR3 checks the battery pack voltage against a reference voltage, generated by digital to analog converter U5. U5 is also controlled by the microprocessor. The results on the output of Comparator AR3 are returned to a single input (PB7), of the I/O portion of U1, for analysis. The input to PB7 is either a logical "1" or a logical "0".

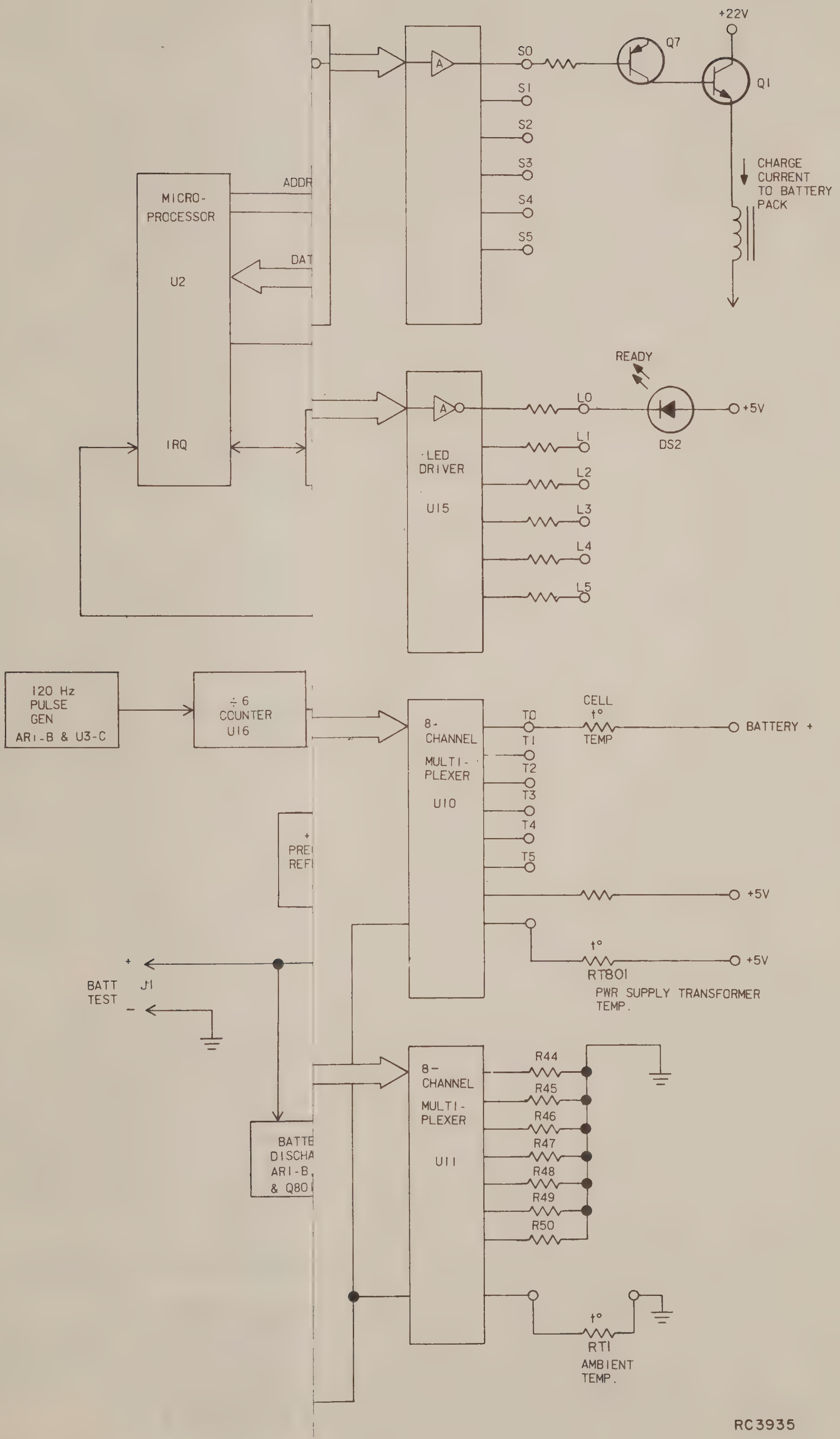
All communication with charger hardware, by the microprocessor is carried out through the 16-bit, I/O port of U1 and the interrupt line ($\overline{\text{IRQ}}$) of microprocessor U2.

Initially, when the AC power cord is plugged into an electrical outlet, capacitor C2 charges up and resets or clears all circuit devices. Microprocessor U2 then, on the first clock pulse, addresses the memory portion of device U1 for the first instruction. All instructions are programmed in U1. Refer to Figure 2.

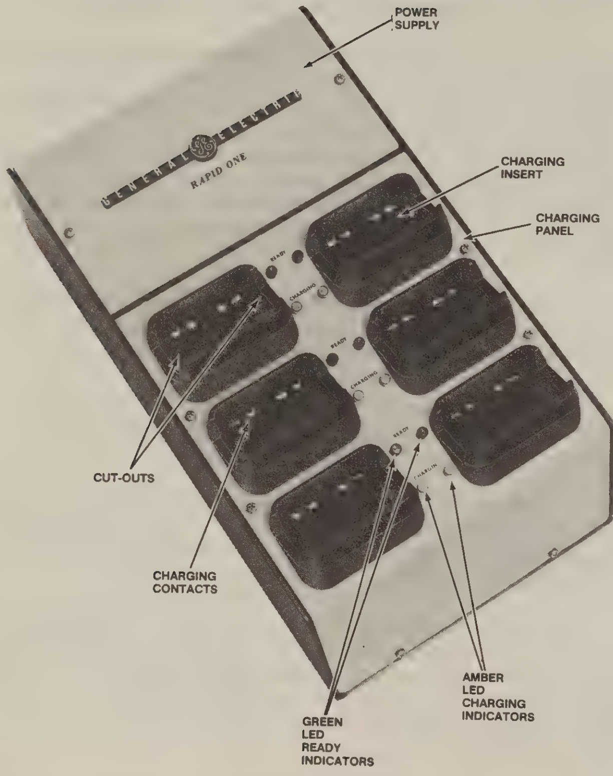
The clock pulse is generated between U2 and NOT circuits U3A and U3B.

When the R/W control line is a logical "1" instructions are "read" from memory into the microprocessor through an eight conductor Data Bus. The microprocessor in turn "writes" output instructions back through the Data Bus through the I/O ports of U1 to an eight conductor Output Bus. The R/W control line is a logical "0" during the "write" mode.

The output bus is connected to the inputs of octal dual flip-flops U6 and the digital inputs of da converter U5. Octal dual flip-flop U6 outputs instructions through two, four conductor address lines to the inputs of eight-bit address latch circuits U7 and U8, Level shifter circuits U9 and optional display units DS1 and DS2.


+22V
Q7
Q1
S0
S1
S2
S3
S4
S5
CHARGE
CURRENT
TO BATTERY
PACK
MICRO-
PROCESSOR
U2
ADDR
DAT
IRQ
READY
L0
L1
L2
L3
L4
L5
+5V
DS2
LED
DRIVER
U15
120 Hz
PULSE
GEN
AR1-B & U3-C
÷ 6
COUNTER
U16
8-
CHANNEL
MULTI-
PLEXER
U10
T0
T1
T2
T3
T4
T5
CELL
t°
TEMP
BATTERY +
+5V
t°
+5V
RT801
PWR SUPPLY TRANSFORMER
TEMP.
PRE
REF
BATT
TEST
J1
+
–
8-
CHANNEL
MULTI-
PLEXER
U11
R44
R45
R46
R47
R48
R49
R50
BATTE
DISCHA
AR1-B,
& Q80
t°
RT1
AMBIENT
TEMP.

RC3935



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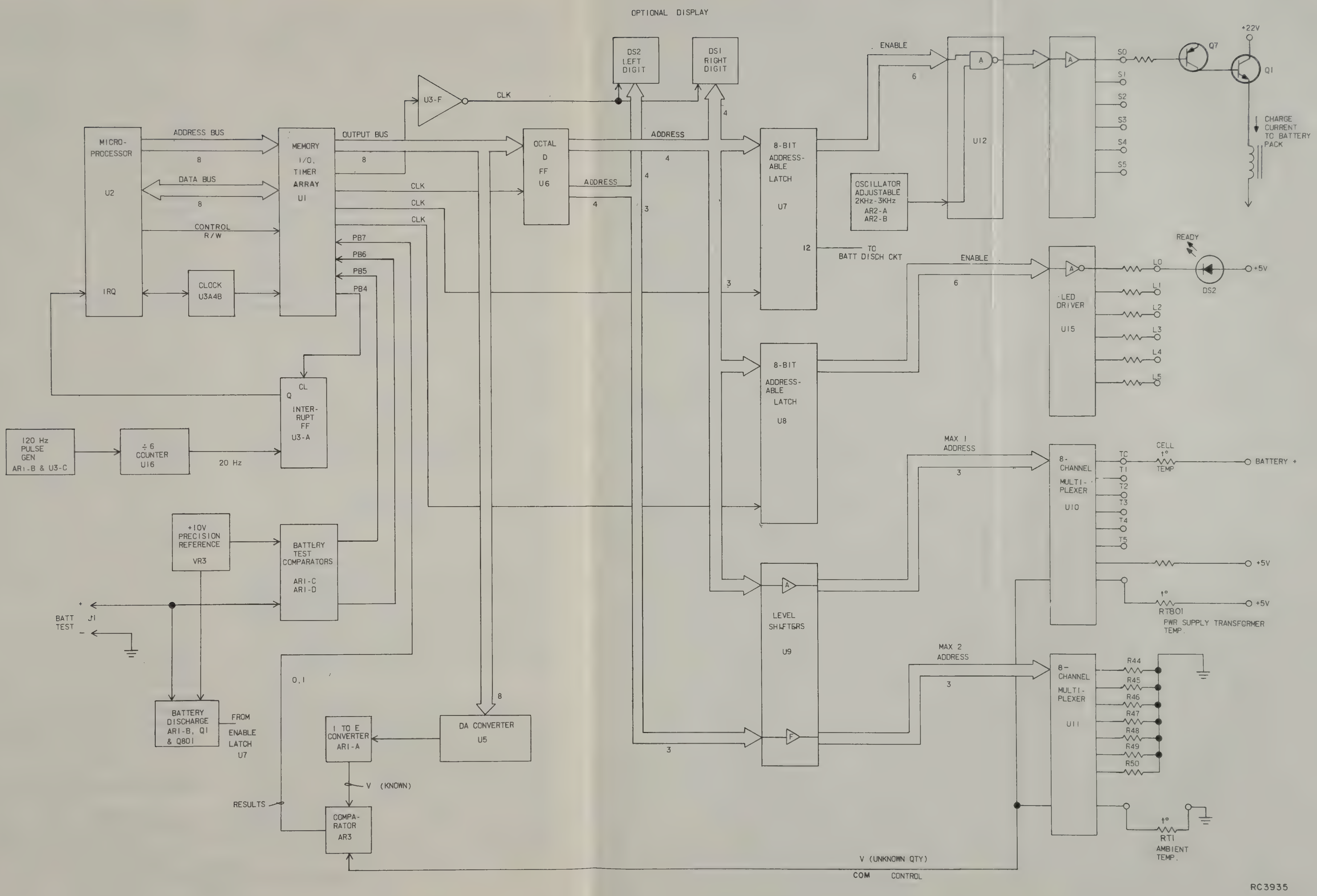
OPTIONAL DISPLAY
DS2 LEFT DIGIT
DS1 RIGHT DIGIT
U3-F
CLK
MICRO-PROCESSOR
U2
IRQ
ADDRESS BUS
8
DATA BUS
8
CONTROL R/W
CLOCK U3A4B
MEMORY I/O, TIMER ARRAY
U1
OUTPUT BUS
8
CLK
CLK
CLK
PB7
PB6
PB5
PB4
OCTAL D FF
U6
ADDRESS
ADDRESS
4
4
4
3
3
4
8-BIT ADDRESS-ABLE LATCH
U7
12
TO BATT DISCH CKT
8-BIT ADDRESS-ABLE LATCH
U8
LEVEL SHIFTERS
U9
A
F
3
ENABLE
6
U12
A
OSCILLATOR ADJUSTABLE 2KHz-3KHz
AR2-A AR2-B
A
S0
S1
S2
S3
S4
S5
Q7
Q1
+22V
CHARGE CURRENT TO BATTERY PACK
READY
ENABLE
6
A
LED DRIVER
U15
L0
L1
L2
L3
L4
L5
DS2
+5V
MAX 1 ADDRESS
3
8-CHANNEL MULTI-PLEXER
U10
TC
T1
T2
T3
T4
T5
CELL t° TEMP
BATTERY +
+5V
t°
RT801
PWR SUPPLY TRANSFORMER TEMP.
+5V
MAX 2 ADDRESS
3
8-CHANNEL MULTI-PLEXER
U11
R44
R45
R46
R47
R48
R49
R50
t°
RT1
AMBIENT TEMP.
CL
Q
INTER-RUPT FF
U3-A
120 Hz PULSE GEN
AR1-B & U3-C
÷6 COUNTER
U16
20 Hz
+10V PRECISION REFERENCE
VR3
BATTERY TEST COMPARATORS
AR1-C AR1-D
+
BATT TEST
J1
−
BATTERY DISCHARGE
AR1-B, Q1 & Q801
FROM ENABLE LATCH U7
0,1
8
DA CONVERTER
U5
I TO E CONVERTER
AR1-A
V (KNOWN)
RESULTS
COMPA-RATOR
AR3
V (UNKNOWN QTY)
COM
CONTROL
RC3935

Figure 2 - Block Diagram

DA converter U5 converts the digital output data of U1 to an analog current. The current from U5 is further converted by I to E converter circuit AR1-A to a voltage. This voltage is connected to an input of comparator circuit AR3 and compared to the output of multi-plexer circuits U10 and U11.

The first series of tests, the microprocessor makes, is to check the ambient temperature. The output from level shifter circuits U9 to the inputs of 8-channel multiplexer circuit U11, connects ambient temperature thermistor RT1 into the circuit. The first ambient temperature test is for excessive ambient. If the ambient temperature is excessive (above 45° C), the resistance of RT1 is low enough to pull the COM control line low. This low voltage or an input of comparator AR3 is comparated to a reference voltage generated by da converter U5. The reference voltage is the analog equalivent of the digital input from the microprocessor to the da converter, and represents the maximum ambient temperature at which the charger will charge. If the temperature is excessive the microprocess will not allow any charging circuits to charge. A multiple charger equipped with the battery discharge option, will write on the display unit "EA", for excessive ambient. "EA" will continue to be displayed until a safe charging condition exist. When a safe condition is present the microprocessor continues its test.

The second ambient temperature test is for a cold ambient. If the ambient temperature is too cold for a safe charge (below 5°C), RT1 is a high resistance. The high value of RT1 causes the COM control line to be high. The high voltage on the COM control line is compared to a reference voltage equivalent to the digital input from the microprocessor to the da converter. The reference voltage this time, represents the minimum safe temperature at which the charger will charge. If the ambient temperature is too cold for safely charging a battery pack, the microprocessor will not allow any charging circuits to charge. A multiple-charger equipped with the battery discharge option will write on the display unit "CO", for cold. "CO" will continue to be displayed until a safe charging condition exist. When, as before, a safe charging condition is present, the microprocessor continues its test.

If an excessive ambient condition or a cold ambient condition does not exist, the microprocessor will then check the temperature of power transformer T801. Inputs to 8-channel multiplexer U10 connects power supply thermister RT801 into the circuit. The resulting voltage on the COM control line is compared to the reference voltage programmed into the da converter by the microprocessor. The first reference voltage corresponds to 60°C. If the temperature of the transformer is less than 60°C, the charger charges as it would normally. If the temperature is higher than 60°C, the microprocessor programs into the da converter a reference voltage corresponding to 70°C. If the temperature of the transformer is less than 70° C, the microprocessor limits the charger to a 50% duty cycle. If the temperature is higher than 70°C the duty cycle is limited to 25%.

Before initiating the charge, the microprocessor executes a temperature and absolute voltage check on each battery pack to be charged. The temperature check is accomplished by connecting the thermistor of each battery pack, one at a time, into the circuit. Voltage on the COM control line is to be compared to a reference voltage generated by the microprocessor and da converter. The first temperature check is for excessive cell temperature. If the cell temperature is higher than 10°C above ambient, the charger will not charge that particular battery pack. The microprocessor will initiate a signal to 8-bit addressable latch U8 to cause the green "READY" indicator to blink until the hot battery pack cools down. If the cell temperature is below 5° C, the charger will not charge that particular battery pack until it has warmed up. The green "READY" indicator will blink the same as with a hot battery pack.

The absolute voltage measurement is accomplished by addressing U11 to connect a high value resistor, 10 meg ohms, into the circuit to form a voltage divider with the battery pack thermistor. This is to measure the open circuit battery voltage. The unknown battery voltage on the COM control line is compared by successive approximation to a known voltage from the microprocessor and da converter. If the unknown voltage is less than the known voltage the seventh bit input, PB7 of the microprocessor, receives a negative sign (0). If the unknown voltage is larger than the known voltage, the seventh bit receives a positive sign (1). Equality is not valid.

After the absolute battery voltage has been established the microprocessor addresses 8-bit addressable latch U7 to open the gate in U12 and start the charge current flowing to the battery pack. The charge current frequency is controlled by oscillator AR2-A & B. This frequency is adjustable from approximately 2000 Hz to 3000 Hz. As the battery pack is charging the voltage and cell temperature checks continue. When a battery pack voltage reaches 9.3 volts or the cell temperature reaches 10°C above ambient, 8-bit addressable latch U8 is addressed to light the green LED READY indicator corresponding to the battery pack being charged. U7 is addressed to stop the high rate of charge. The battery pack then goes to trickle charge.

Optional Battery Discharger

The optional battery discharger circuit is a controlled current sink for a 750 mAh or 1200 mAh, MPR battery pack. Its function is to discharge a fully charged battery pack to 6 volts and display the percentage of an hour required.

As an alternative to displaying the percentage of time, the battery discharge can be modified to display the actual time. Time display is available in 60 Hz units only.

The fully charged battery pack is connected to battery discharge connector J1. When the microprocessor has completed all other checks on battery packs being charged, it then checks to see if a battery pack is present at J1. If a battery pack is present and the output of comparator AR1-D is high, the battery pack voltage is larger than 6 volts and has not been discharged. The discharge will not start if the battery pack voltage is less than 6 volts. If a battery pack is not present at J1, the output of comparator AR1-C will be high indicating the voltage at J1 less than 3 volts or missing. The microprocessor will then continue its normal routine.

With the fully charged battery pack present at J1, and the 5th bit (PB5) high, the microprocessor addresses U7 to initiate the discharger circuit. The display unit displays DC. Current sink transistors Q1 and Q801 conducts at a controlled rate determined by S1 and AR1-A (750/1200 mA). As the battery pack is discharging the battery voltage is compared by comparator AR1-C to a ten volt reference generated by voltage regulator UR3. The reference voltage is dropped to 6 volts on the negative input terminal of AR1-C. When the battery pack voltage drops to 6 volts the output of AR1-C goes low. The low on the 6th bit (PB6), of the microprocessor stops the discharge. The microprocessor then displays on the display unit the percentage of time or time required for the discharge.

The 120 Hz pulse generator AR1-B, inverter U3-C, Counter U16 and interrupt flip-flop U4-A, provide from the power line frequency, the time base for recording the duration of the battery discharge test. The interrupt service routine clears the interrupt flip-flop at the end of execution.

Power Supply

The power supply for the MPR one hour multi-charger can be powered from a 121 VAC (50/60 Hz) source or a 240 VAC (50/60 Hz) source. The component difference between the AC power requirements is the power transformer. For 121 VAC domestic requirements, the power supply uses transformer T801. For 240 VAC domestic requirements and 105 VAC through 240 VAC international requirements the power supply uses transformer T802.

Both transformers T801 and T802 are step down transformers from the primary voltage to 10 volts ±0.5 volts at 4 amps.

The secondary of the power transformer is connected across a diode bridge rectifier circuit consisting of CR801, CR802, CR1 and CR2. The transformer secondary is also connected across a half-wave rectifier circuit consisting of diodes CR3 and CR4.

The output of diodes CR801 and CR802 at H11 is connected to the inputs of voltage regulator circuits VR801 and VR802. VR801 provides a regulated +12 VDC at H4 of circuit board A801. VR802 provides a regulated +5 VDC at H5 of circuit board A801.

The output of diodes CR3 and CR4 provide a +16 to a +22 VAC at H3 of A801. This AC voltage source provides the timing for the 120 Hz pulse generator as well as being the charging voltage.

The output of diodes CR1 and CR2 at H24 is connected to the input of voltage regulator circuit VR803. VR803 provides a -12 VDC at H7 of A801. The -12 VDC is used to power da converter U5.

INSTALLATION
(ON WALL)

Multi-chargers should be mounted on a wall close to the applicable AC (50/60 Hertz) source. Care should be taken when mounting to insure proper top and bottom ventilation. A minimum air space of two inches is required between the bottom of a multi-charger and other surfaces.

MAINTENANCE

Access

To gain access to the circuitry of the charger combination, first remove the AC power to the charger, then remove the ten screws holding the panel in the base. Lift the panel from the base. The charger panel must be removed to replace any LED indicators. To replace a fuse it is necessary only to remove the fuse from the fuse holder on power supply.

Troubleshooting

Should a difficult service problem arise, the following Troubleshooting Procedure is provided to assist the service technician. Also, voltages are provided on the Schematic Diagram to further assist the service technician to isolate any problem.

GENERAL ELECTRIC COMPANY• MOBILE COMMUNICATIONS DIVISION
WORLD HEADQUARTERS • LYNCHBURG, VIRGINIA 24502 U.S.A.

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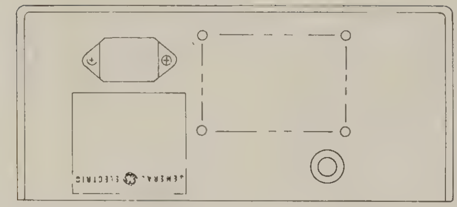
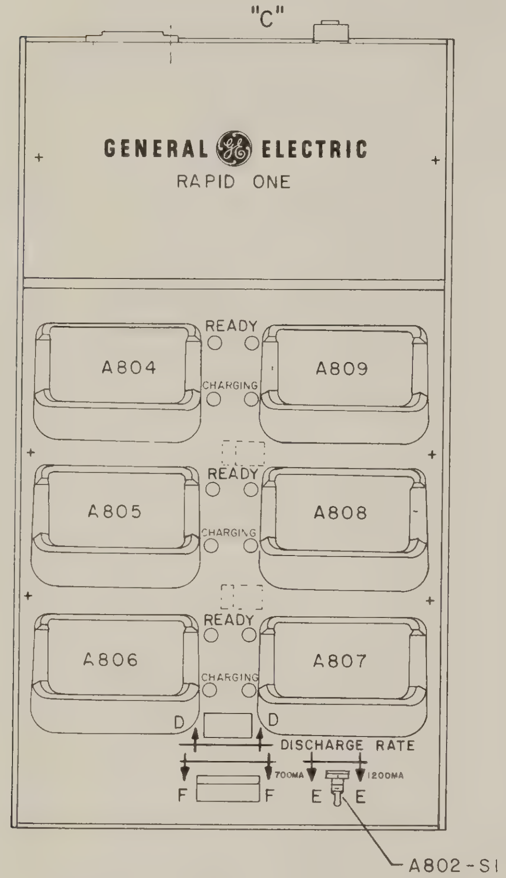
U.S.A.

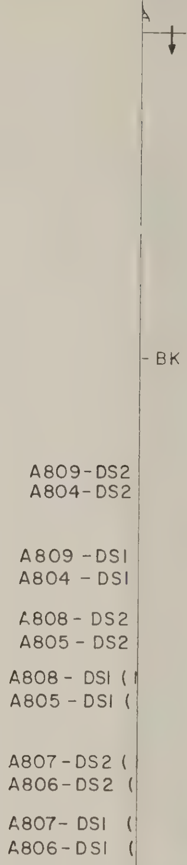
* Trademark of General Electric Company U.S.A.
Printed in U.S.A.

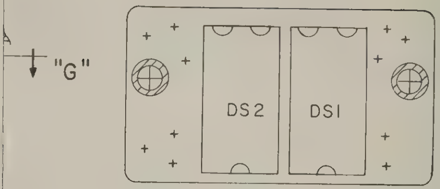

GENERAL ELECTRIC

VIEW IN DIRECTION OF ARROW "C"

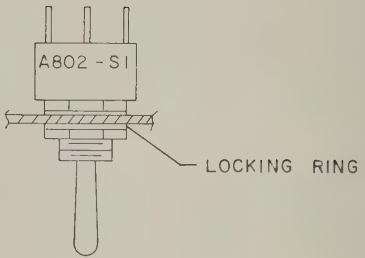

"C"
GENERAL ELECTRIC
RAPID ONE
A804
A809
A805
A808
A806
A807
READY
CHARGING
READY
CHARGING
READY
CHARGING
D
D
DISCHARGE RATE
700MA
1200MA
F
F
E
E
A802-S1

VIEW IN DIRECTION OF ARROW "B"

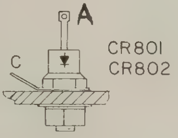

- BK
A809-DS2
A804-DS2
A809 - DS1
A804 - DS1
A808 - DS2
A805 - DS2
A808 - DS1 (
A805 - DS1 (
A807 - DS2 (
A806 - DS2 (
A807 - DS1 (
A806 - DS1 (



SECTION "G"-"G"
ORIENTATION IMPORTANT


A802 - S1
LOCKING RING

SECTION "E"-"E"


A
C
CR801
CR802

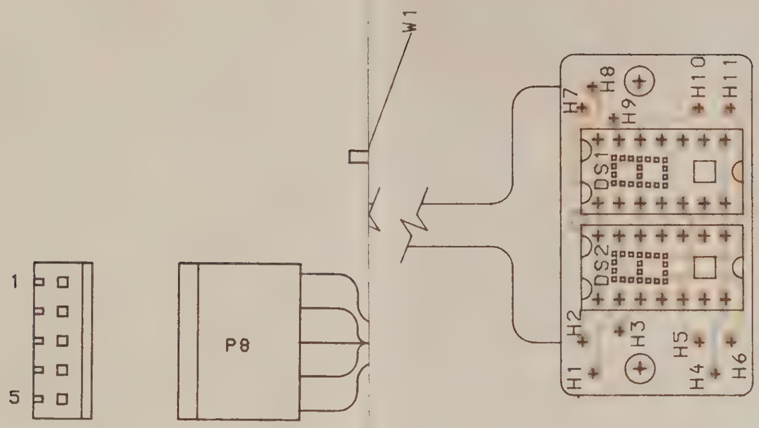
DETAIL "A"

OUTLINE DIAGRAM

RAPID 1 MULTI-CHARGER
(Sheet 1)

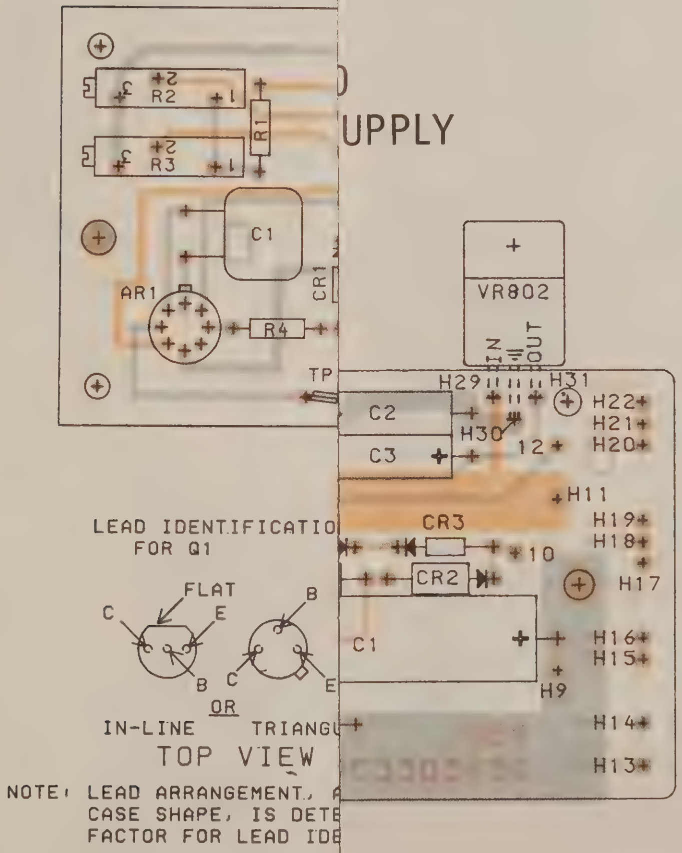
3

BAT BOARD


W1
1
5
P8
H7
H8
H9
H10
H11
DS1
DS2
H1
H2
H3
H4
H5
H6

, 0)
1. Rev. 0)
2. Rev. 0)

UPPLY


R2
R3
R1
C1
AR1
R4
CR1
TP
VR802
IN
OUT
H29
H31
H22
H21
H20
C2
C3
H30
12
H11
CR3
H19
H18
10
CR2
H17
C1
H16
H15
H9
H14
H13
LEAD IDENTIFICATIO
FOR Q1
FLAT
C
E
B
B
C
E
OR
IN-LINE
TRIANGU
TOP VIEW
NOTE: LEAD ARRANGEMENT, A
CASE SHAPE, IS DETE
FACTOR FOR LEAD IDE

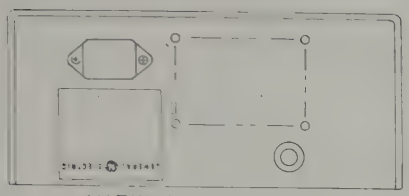
ev. 0)
. 1, Rev. 0)
. 2, Rev. 0)

OUTLINE DIAGRAM

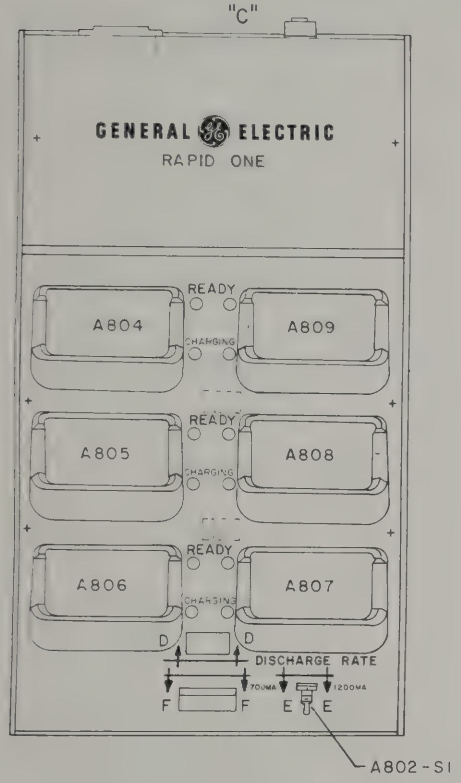
IDE

RAPID 1 MULTI-CHARGER
(Sheet 2)

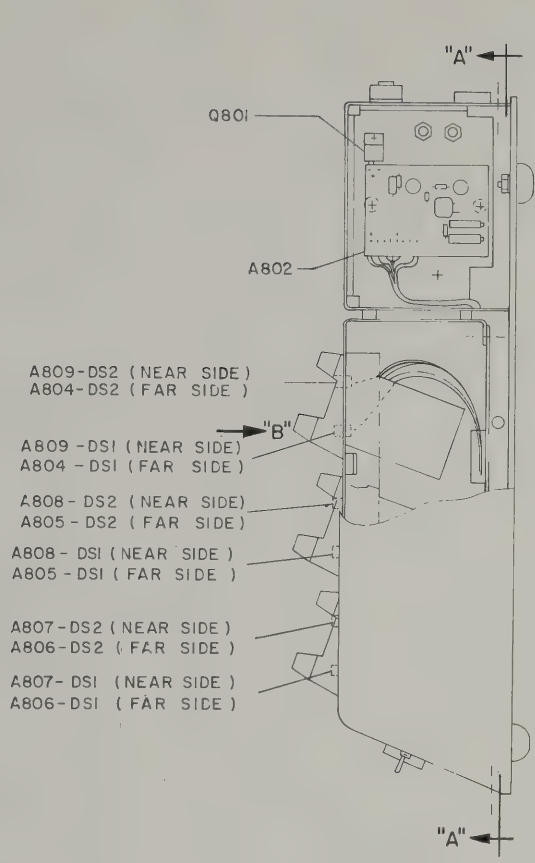
NT SID

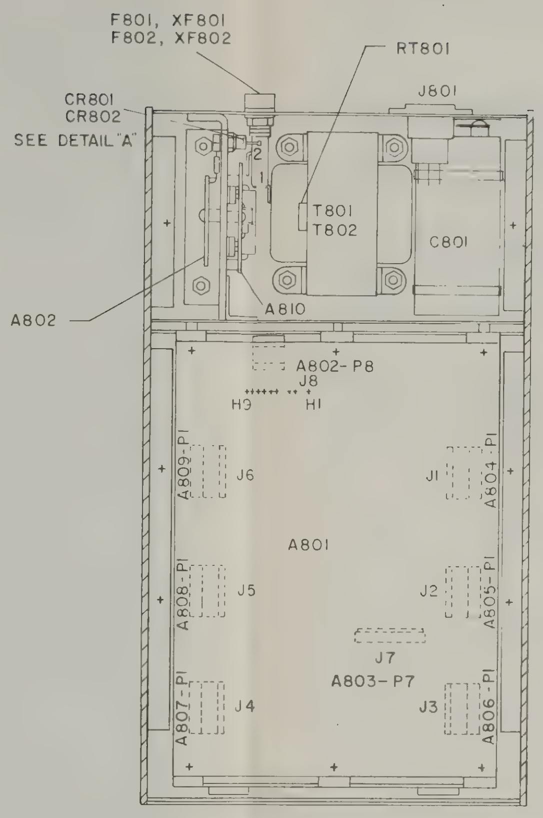

GENERAL ELECTRIC

VIEW IN DIRECTION
OF ARROW "C"


"C"
GENERAL ELECTRIC
RAPID ONE
A804
A809
READY
CHARGING
A805
A808
A806
A807
D
DISCHARGE RATE
F
E
700MA
1200MA
A802-S1

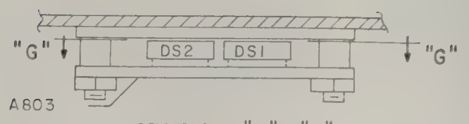
VIEW IN DIRECTION
OF ARROW "B"


"A"
Q801
A802
A809-DS2 (NEAR SIDE)
A804-DS2 (FAR SIDE)
"B"
A809-DS1 (NEAR SIDE)
A804-DS1 (FAR SIDE)
A808-DS2 (NEAR SIDE)
A805-DS2 (FAR SIDE)
A808-DS1 (NEAR SIDE)
A805-DS1 (FAR SIDE)
A807-DS2 (NEAR SIDE)
A806-DS2 (FAR SIDE)
A807-DS1 (NEAR SIDE)
A806-DS1 (FAR SIDE)
"A"

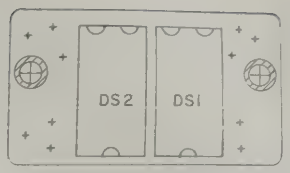

F801, XF801
F802, XF802
RT801
CR801
CR802
SEE DETAIL "A"
J801
T801
T802
C801
A802
A810
A802-P8
J8
H9
H1
A809-P1
J6
J1
A804-P1
A801
A808-P1
J5
J2
A805-P1
J7
A803-P7
A807-P1
J4
J3
A806-P1

SECTION "A"-"A"

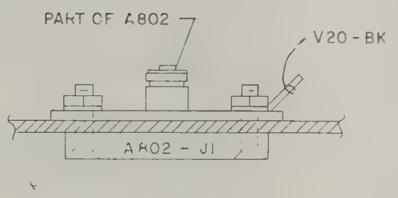
(19D430976, Rev. 0)


"G"
DS2
DS1
"G"
A803

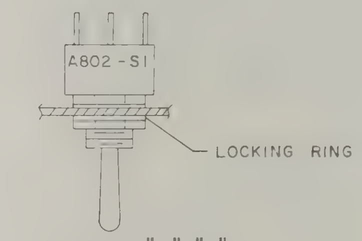
SECTION "D"-"D"



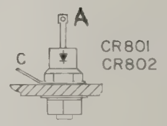
SECTION "G"-"G"
ORIENTATION IMPORTANT


PART OF A802
V20-BK
A802 - J1

SECTION "F"-"F"

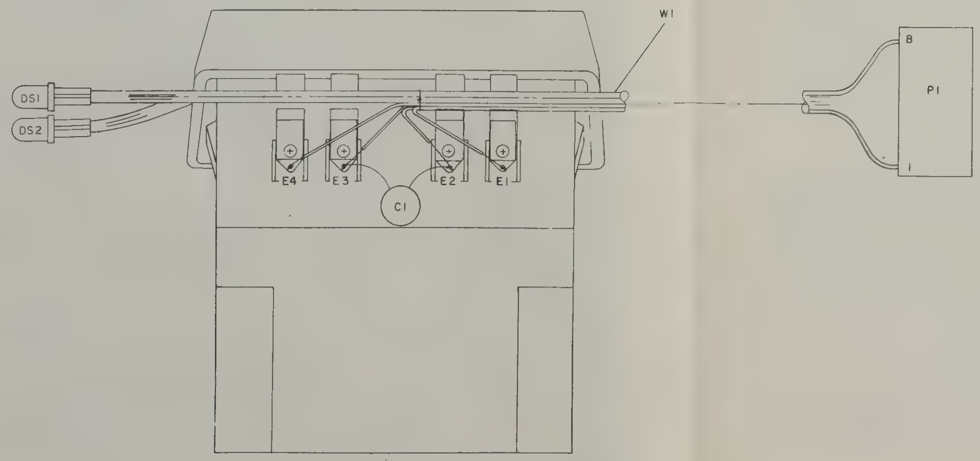

A802-S1
LOCKING RING

SECTION "E"-"E"


A
C
CR801
CR802

DETAIL "A"

A804-A809

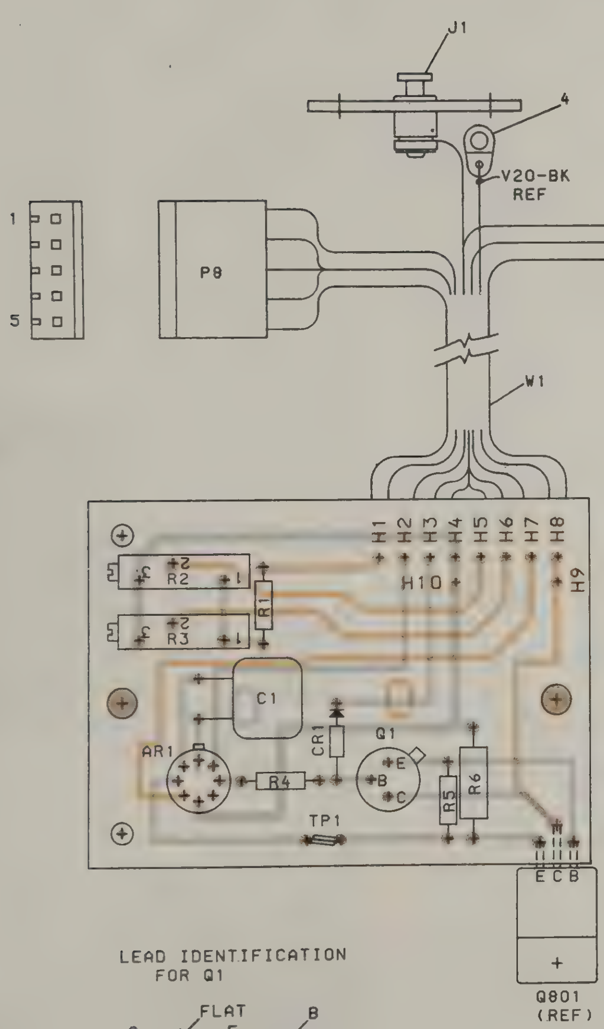

W1
DS1
DS2
E4
E3
E2
E1
C1
B
P1
1

(19C330612, Rev. 0)

OUTLINE DIAGRAM

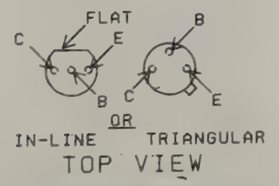
RAPID 1 MULTI-CHARGER
(Sheet 1)

A802
BATTERY DISCHARGE BOARD


J1
4
V20-BK
REF
S1
1
2
3
1
5
P8
W1
H1
H2
H3
H4
H5
H6
H7
H8
H9
H10
R2
R3
R1
C1
CR1
Q1
AR1
R4
R5
R6
TP1
E C B
+
Q801
(REF)

FROM	TO	WIRE
H1	P8-1	SF24-W
H2	P8-5	SF24-BL
H3	P8-3	SF24-O
H4	P8-2	SF24-BK
H5	S1-1	SF24-G
H6	S1-3	SF24-Y
H7	S1-2	SF24-V
H8	P8-4	SF24-R
H9	J1	V20-R
H10	ITEM 4 LET HANG	V20-BK

LEAD IDENTIFICATION
FOR Q1

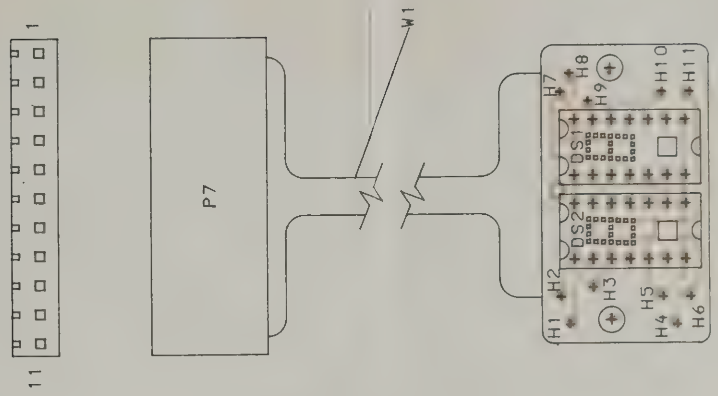

FLAT
C
E
B
B
C
E
IN-LINE
OR
TRIANGULAR

TOP VIEW

NOTE: LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

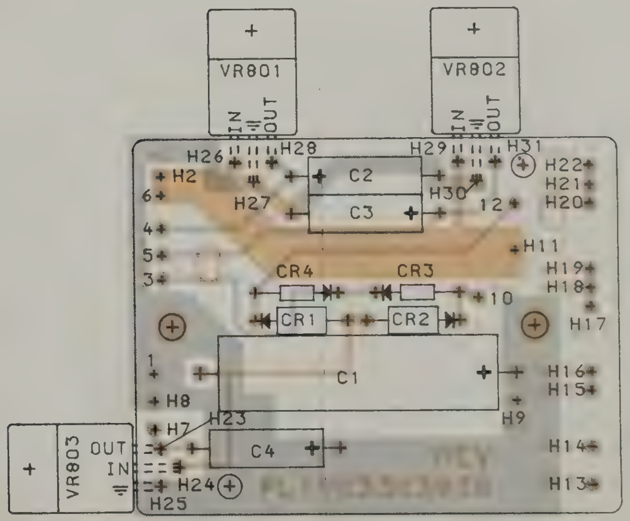
(19C330182, Rev. 0)
(19A138479, Sh. 1, Rev. 0)
(19A138479, Sh. 2, Rev. 0)

A803
DISPLAY BOARD

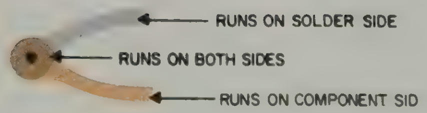

1
11
P7
W1
H1
H2
H3
H4
H5
H6
H7
H8
H9
H10
H11
DS1
DS2

(19B233318, Rev. 0)
(19A142579, Sh. 1, Rev. 0)
(19A142579, Sh. 2, Rev. 0)

A810
POWER SUPPLY

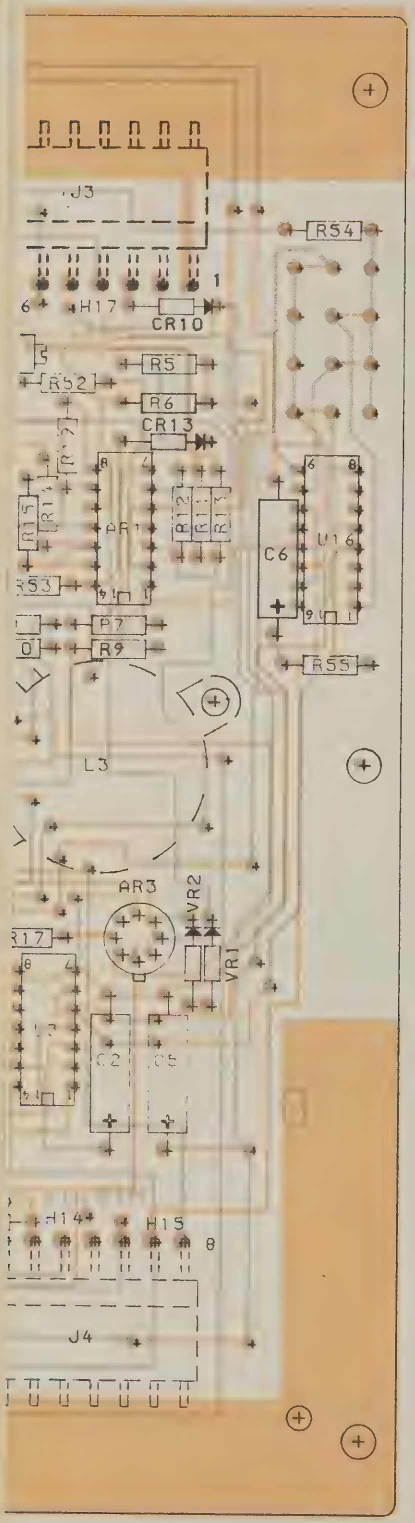

VR801
IN
OUT
VR802
IN
OUT
H26
H28
H29
H31
H2
C2
H30
H22
H21
H20
6
H27
C3
12
4
5
3
H11
CR4
CR3
H19
H18
10
CR1
CR2
H17
1
C1
H16
H15
H8
H9
H23
H7
VR803
OUT
IN
C4
H14
H24
H25
H13

(19C330395, Rev. 0)
(19A142786, Sh. 1, Rev. 0)
(19A142786, Sh. 2, Rev. 0)


RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SID

OUTLINE DIAGRAM

RAPID 1 MULTI-CHARGER
(Sheet 2)

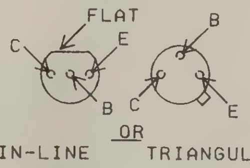

J3
R54
6
H17
CR10
1
R5
R52
R6
CR13
AR1
R15
R14
R12
R11
R13
C6
U16
R53
R7
R9
R55
L3
AR3
VR2
VR1
R17
C2
C5
H14
H15
8
J4

CONNECTION CHART

FROM		TO
L1	Y	H21
	BK	H20
L2	Y	H19
	BK	H18
L3	Y	H17
	BK	H16
L4	Y	H15
	BK	H14
L5	Y	H13
	BK	H12
L6	Y	H11
	BK	H10
TB1	1◆◆	H22
	2◆	H23

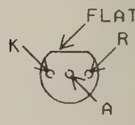
◆◆SF24-W
◆SF24-BK

LEAD IDENTIFICATION
FOR Q7-Q12


FLAT
C
E
B
B
C
E
OR

IN-LINE TRIANGULAR
TOP VIEW

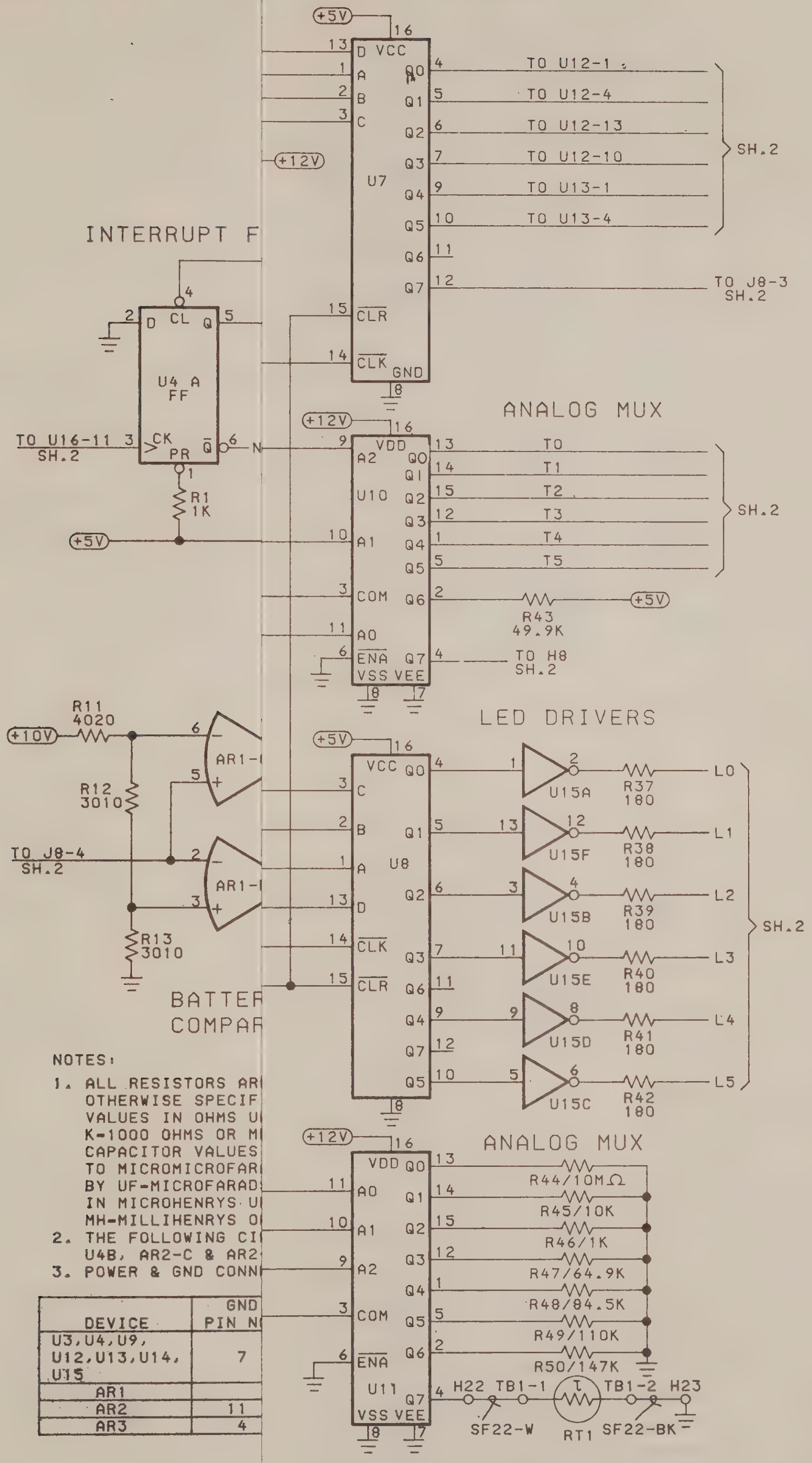
LEAD IDENTIFICATION
FOR VR3



IN-LINE
TOP VIEW

NOTE: LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

)
Rev. 0)
Rev. 0)


+5V
U7
D VCC
A
B
C
Q0
Q1
Q2
Q3
Q4
Q5
Q6
Q7
CLR
CLK
GND
TO U12-1
TO U12-4
TO U12-13
TO U12-10
TO U13-1
TO U13-4
SH.2
TO J8-3
SH.2
+12V
INTERRUPT F
U4 A
FF
D CL Q
CK PR Q̄
TO U16-11
SH.2
R1
1K
+5V
ANALOG MUX
U10
VDD
A2
A1
A0
COM
ENA
VSS VEE
T0
T1
T2
T3
T4
T5
SH.2
R43
49.9K
TO H8
SH.2
R11
4020
+10V
R12
3010
R13
3010
AR1-
TO J8-4
SH.2
BATTER
COMPAR
LED DRIVERS
U8
U15A
U15F
U15B
U15E
U15D
U15C
R37
180
R38
180
R39
180
R40
180
R41
180
R42
180
L0
L1
L2
L3
L4
L5
SH.2
ANALOG MUX
U11
R44/10MΩ
R45/10K
R46/1K
R47/64.9K
R48/84.5K
R49/110K
R50/147K
H22
TB1-1
RT1
TB1-2
H23
SF22-W
SF22-BK

NOTES:

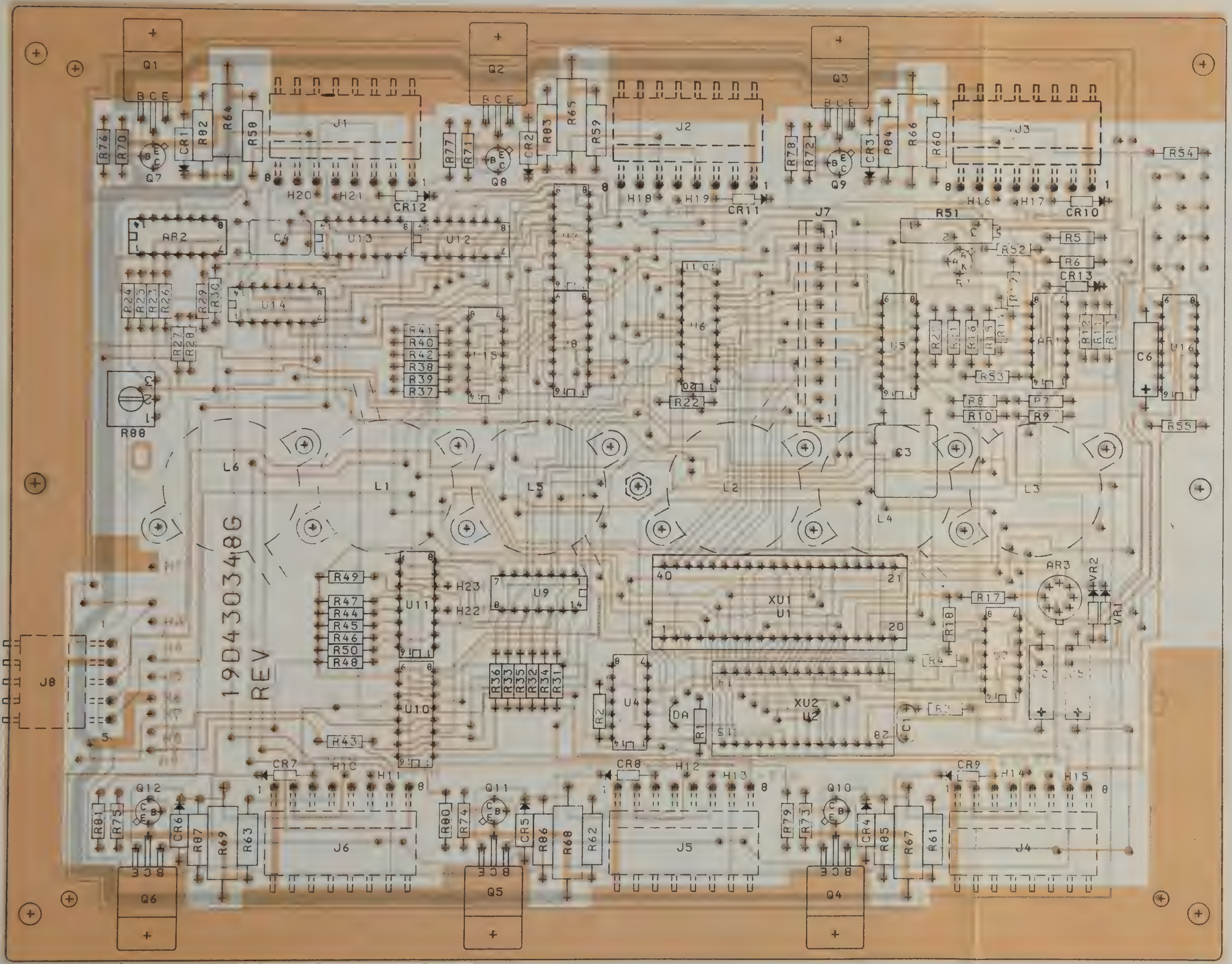
1. ALL RESISTORS AR
OTHERWISE SPECIF
VALUES IN OHMS U
K-1000 OHMS OR M
CAPACITOR VALUES
TO MICROMICROFAR
BY UF-MICROFARAD
IN MICROHENRYS U
MH-MILLIHENRYS O
2. THE FOLLOWING CI
U4B, AR2-C & AR2
3. POWER & GND CONN

DEVICE	GND PIN N
U3, U4, U9, U12, U13, U14, U15	7
AR1	
AR2	11
AR3	4

SCHEMATIC DIAGRAM

RAPID 1 MULTI-CHARGER
(Sheet 1)

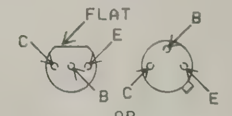
A801
CHARGER BOARD


Q1
Q2
Q3
B C E
J1
J2
J3
R76
R70
Q7
CR1
R82
R64
R58
R77
R71
Q8
CR2
R83
R65
R59
R78
R72
Q9
CR3
R84
R66
R60
R54
H20
H21
CR12
H18
H19
CR11
H16
H17
CR10
J7
R51
AR2
C4
U13
U12
U7
R5
R52
R6
CR13
R24
R25
R27
R26
R29
R30
U14
R41
R40
R42
R38
R39
R37
U15
U8
U6
U5
AR1
U16
C6
R27
R28
R88
R22
R53
R8
R7
R10
R9
R55
C3
L6
L1
L5
L2
L3
L4
19D430348G
REV
R49
R47
R44
R45
R46
R50
R48
U11
H23
H22
U9
XU1
U1
40
21
1
20
AR3
VR2
VR1
R17
R18
J8
R36
R35
R33
R32
R34
R31
U10
U4
R2
DA
R1
XU2
U2
R43
CR7
H10
H11
CR8
H12
H13
CR9
H14
H15
Q12
Q11
Q10
R81
R75
CR6
R87
R69
R63
J6
R80
R74
CR5
R86
R68
R62
J5
R79
R73
CR4
R85
R67
R61
J4
Q6
Q5
Q4

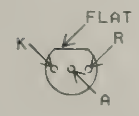
CONNECTION CHART		
FROM		TO
L1	Y	H21
	BK	H20
L2	Y	H19
	BK	H18
L3	Y	H17
	BK	H16
L4	Y	H15
	BK	H14
L5	Y	H13
	BK	H12
L6	Y	H11
	BK	H10
TB1	1◆◆	H22
	2◆	H23

◆◆SF24-W
◆SF24-BK

LEAD IDENTIFICATION
FOR Q7-Q12

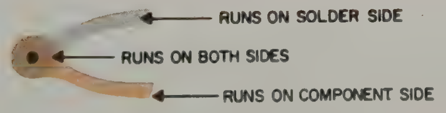

FLAT
C
E
B
B
C
E
OR
IN-LINE
TRIANGULAR
TOP VIEW

LEAD IDENTIFICATION
FOR VR3


FLAT
K
R
A
IN-LINE
TOP VIEW

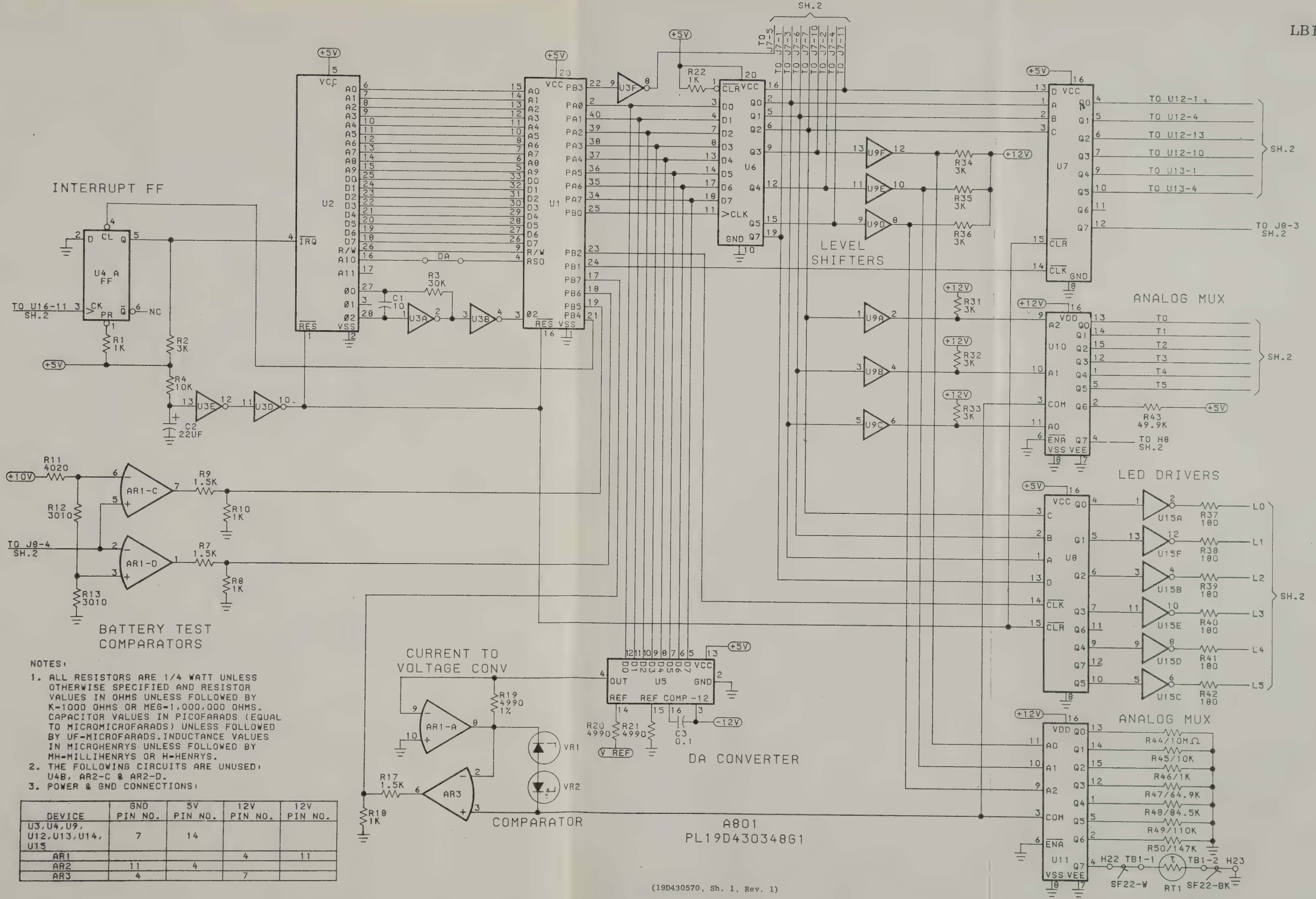
NOTE: LEAD ARRANGEMENT, AND NOT
CASE SHAPE, IS DETERMINING
FACTOR FOR LEAD IDENTIFICATION.

OUTLINE DIAGRAM


RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE

(19D430349, Rev. 0)
(19A138447, Sh. 1, Rev. 0)
(19A138447, Sh. 2, Rev. 0)

RAPID 1 MULTI-CHARGER
(Sheet 3)


SH.2
INTERRUPT FF
U4 A FF
TO U16-11 SH.2
R1 1K
R2 3K
R4 10K
C2 22UF
+5V
U2
U1
R3 30K
C1 10
U3A
U3B
U3C
U3D
U3E
U3F
DA
R22 1K
U6
U7
LEVEL SHIFTERS
U9A
U9B
U9C
U9D
U9E
U9F
R31 3K
R32 3K
R33 3K
R34 3K
R35 3K
R36 3K
+12V
TO U12-1
TO U12-4
TO U12-13
TO U12-10
TO U13-1
TO U13-4
TO J8-3 SH.2
ANALOG MUX
U10
T0
T1
T2
T3
T4
T5
R43 49.9K
TO H8 SH.2
LED DRIVERS
U8
U15A
U15B
U15C
U15D
U15E
U15F
R37 180
R38 180
R39 180
R40 180
R41 180
R42 180
L0
L1
L2
L3
L4
L5
U11
R44/10MΩ
R45/10K
R46/1K
R47/64.9K
R48/84.5K
R49/110K
R50/147K
H22
TB1-1
RT1
TB1-2
H23
SF22-W
SF22-BK
+10V
R11 4020
R12 3010
R13 3010
AR1-C
AR1-D
R9 1.5K
R10 1K
R7 1.5K
R8 1K
TO J8-4 SH.2
BATTERY TEST COMPARATORS
CURRENT TO VOLTAGE CONV
AR1-A
R19 4990 1%
VR1
VR2
AR3
R17 1.5K
R18 1K
COMPARATOR
U5
R20 4990
R21 4990
C3 0.1
V REF
-12V
DA CONVERTER
A801
PL19D430348G1

NOTES:

1. ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K-1000 OHMS OR MEG-1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF-MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH-MILLIHENRYS OR H-HENRYS.
2. THE FOLLOWING CIRCUITS ARE UNUSED: U4B, AR2-C & AR2-D.
3. POWER & GND CONNECTIONS:

DEVICE	GND PIN NO.	5V PIN NO.	12V PIN NO.	12V PIN NO.
U3, U4, U9, U12, U13, U14, U15	7	14		
AR1			4	11
AR2	11	4		
AR3	4		7	

(19D430570, Sh. 1, Rev. 1)

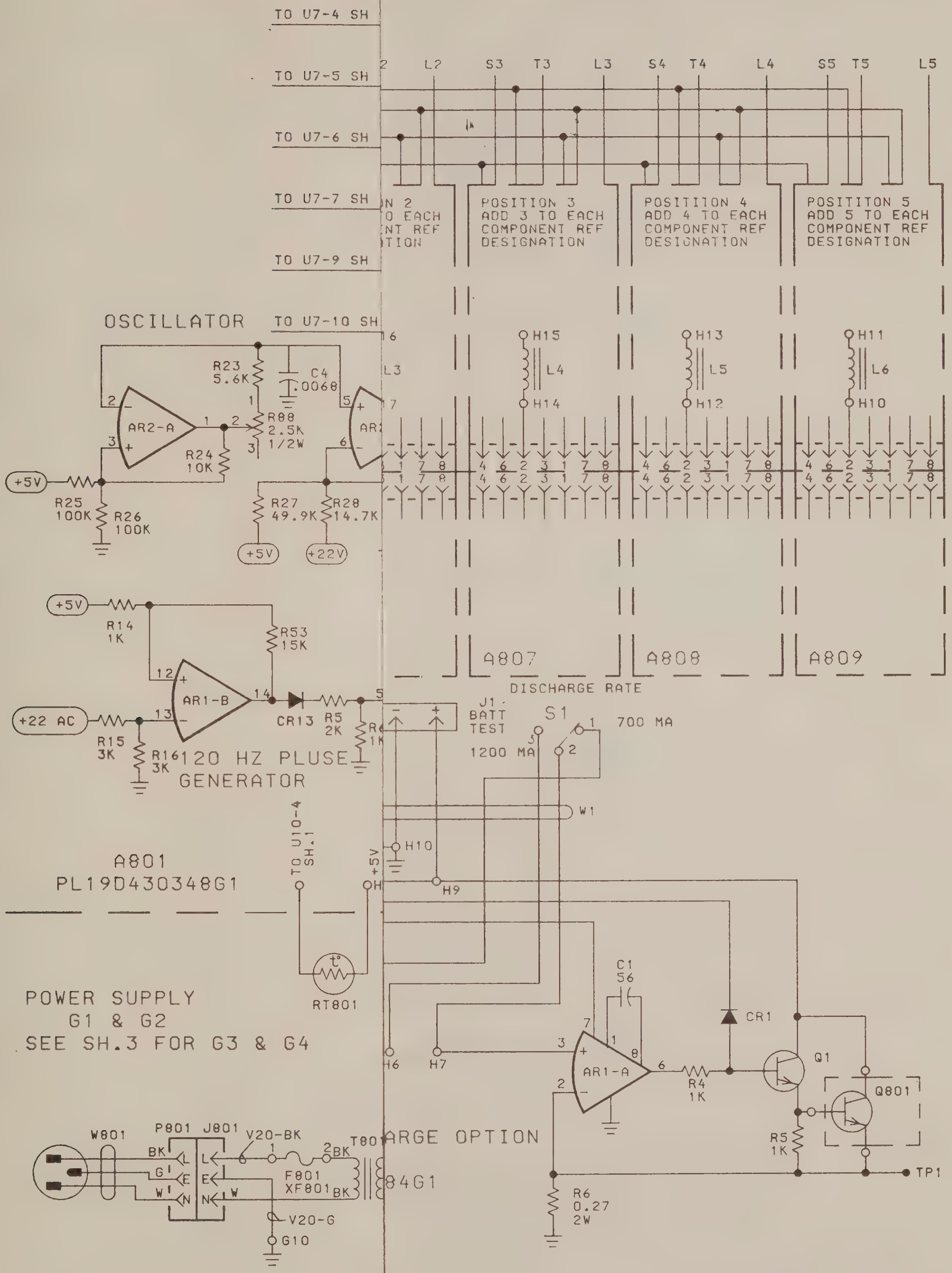
SCHEMATIC DIAGRAM

RAPID 1 MULTI-CHARGER
(Sheet 1)

Issue 1

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - TERMINAL BOARDS - - - - - - - - -
TB1	7487424P10	Miniature, phen: 2 terminals.
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - -
U1	19A134782P1	Digital, Outline For 40 Pin Plastic Dip Case: Identification No. 4782P1.
U2	19A134714P2	Digital, Outline For 28 Pin Dip Case: 6505 Microprocessor, plastic package with tin leads.
U3	19A134305P13	Digital, Hex Schmitt-Trigger Inverter: Identification No. 74LS14.
U4	19A134305P35	Digital, Dual D-Type Positive Edge-Triggered: Identification No. 74LS74.
U5	19A134826P1	Silicon, Outline For 16-Pin Dip Case; sim to MC1408L8.
U6	19A134305P111	Digital, Octal D F-F With Clear, Outline For 20-Pin: Identification No. 74LS273.
U7 and U8	19A134305P110	Digital, Triple 3 Input Positive-And Gate: Identification No. 74LS11.
U9	19A116180P56	Digital, Hex Buffers/Drivers w/Open-Collector High Voltage Output: Identification No. 7407.
U10 and U11	19A134097P43	Digital, Single 8-Channel Multiplexer: Identification No. 4051.
U12 and U13	19A134305P1	Digital, Quad 2-Input Positive-Nand Gate: Identification No. 74LS00.
U14	19A116180P56	Digital, Hex Buffers/Drivers w/Open-Collector High Voltage Output: Identification No. 7407.
U15	19A116180P33	Digital, Hex Inverter Buffers/Driver (Open Collector): Identification No. 7416.
U16	19A134305P81	Digital, Synchronous 4-Bit Up/Down Binary Counter: Identification No. 74LS193.
		- - - - - - - - VOLTAGE REGULATORS - - - - - - -
VR1 and VR2	4036887P6	Zener: 500 mW, 6.5 v. nominal.
VR3	19A134936P1	Integrated circuit, linear: sim to T1 TL430C.
		- - - - - - - - - - - SOCKETS - - - - - - - - - -
XU1	19A700156P5	Socket, integrated circuit: 40 positions; sim to Burndy DILB40P-108.or Augat 340-AG39D or AMP 640379-3.
XU2	19A700156P3	Socket, integrated circuit: 28 positions; sim to Burndy DILB28P-108 or Augat 328-AG39D or AMP 640362-3.
A802		BATTERY DISCHARGE BOARD 19C330184G1
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - -
AR1	19A134379P1	Linear, TO-99 CASE; sim to RCA CA3130T.
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C1	19A700105P28	Mica: 56 pf ±5%, 500 VDCW.
		- - - - - - - - DIODES AND RECTIFIERS - - - - - -
CR1	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
		- - - - - - - JACKS AND RECEPTACLES - - - - - - -
J1	19B233306G1	Contact.
		- - - - - - - - - - - PLUGS - - - - - - - - - - -
P8		Connector. Includes:
	19A116659P18	Shell.
	19A116781P5	Contact, electrical: sim to Molex 08-50-0106.

Parts List Cont'd on page 12


TO U7-4 SH
TO U7-5 SH
TO U7-6 SH
TO U7-7 SH
TO U7-9 SH
TO U7-10 SH
L2 S3 T3 L3 S4 T4 L4 S5 T5 L5
POSITION 3 ADD 3 TO EACH COMPONENT REF DESIGNATION
POSITION 4 ADD 4 TO EACH COMPONENT REF DESIGNATION
POSITIITON 5 ADD 5 TO EACH COMPONENT REF DESIGNATION
H15 L4 H14
H13 L5 H12
H11 L6 H10
A807
A808
A809
DISCHARGE RATE
OSCILLATOR
R23 5.6K
C4 .0068
R88 2.5K 1/2W
AR2-A
R24 10K
+5V
R25 100K
R26 100K
R27 49.9K
R28 14.7K
+22V
+5V
R14 1K
R53 15K
AR1-B
CR13
R5 2K
+22 AC
R15 3K
R16 3K
120 HZ PLUSE GENERATOR
J1 BATT TEST
S1
700 MA
1200 MA
W1
H10
H9
A801
PL19D430348G1
TO U10-4 SH.1
+5V
RT801
POWER SUPPLY G1 & G2
SEE SH.3 FOR G3 & G4
H6
H7
C1 56
CR1
AR1-A
R4 1K
Q1
Q801
R5 1K
TP1
R6 0.27 2W
W801
P801 J801
V20-BK
BK G W
L E N
F801 XF801
T801
V20-G
G10
ARGE OPTION
84G1

SCHEMATIC DIAGRAM

RAPID 1 MULTI-CHARGER
(Sheet 2)

Issue 1

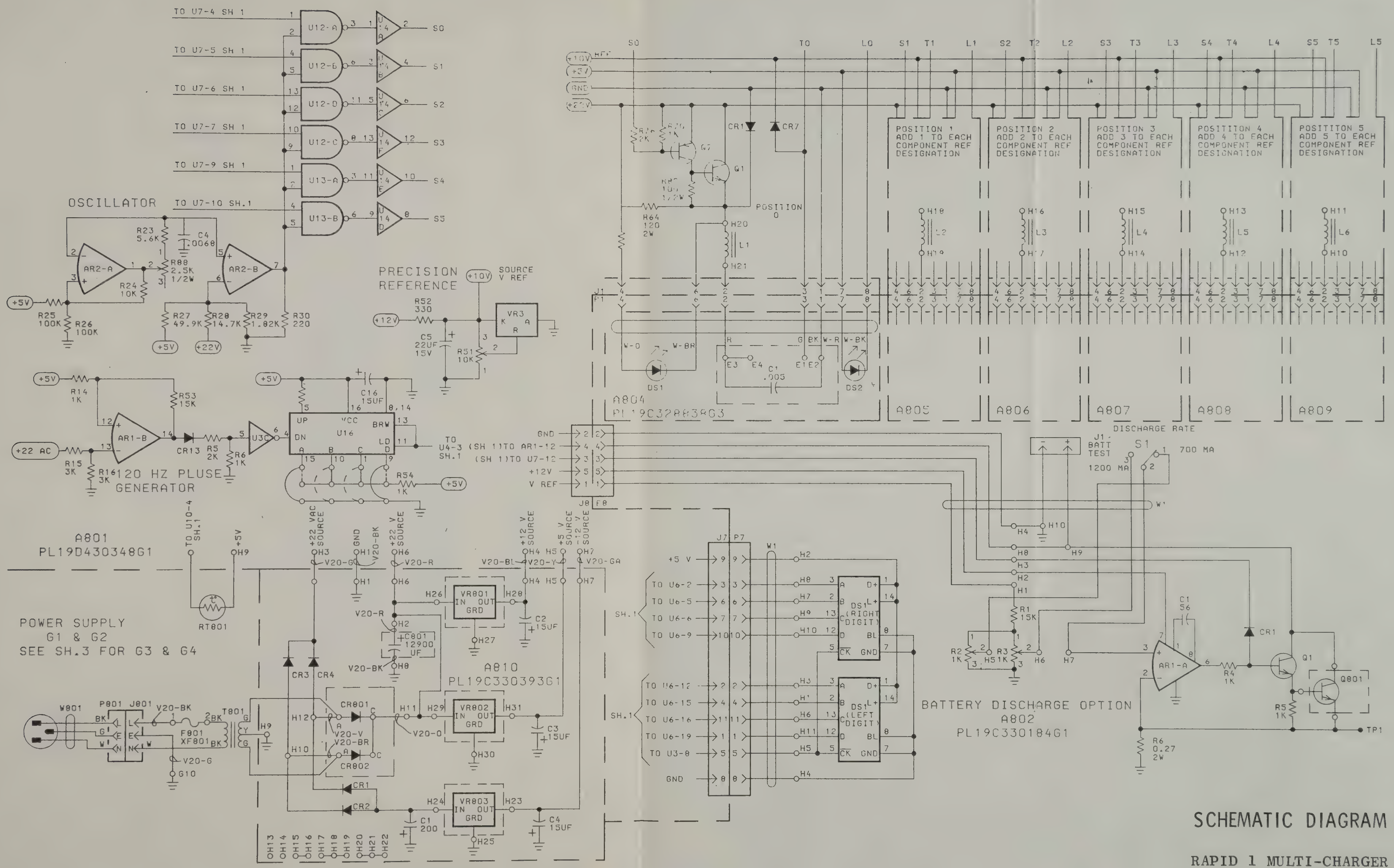
PARTS LIST

MPR 1-HOUR MULTI-CHARGER
19D430514G1 120 V DISCHARGE OPTION
19D430514G2 120 V
19D430514G3 240 V DISCHARGE OPTION
19D430514G4 240 V
ISSUE 1

SYMBOL	GE PART NO.	DESCRIPTION
A801		CHARGER BOARD 19D430348G1
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - -
AR1 and AR2	19A134511P1	Linear, Quad OP AMP; sim to NSCLM 224J.
AR3	19A134379P1	Linear, TO-99 CASE; sim to RCA CA3130T.
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C1	19A116656P10J8	Ceramic disc: 10 pf ±0.5 pf, 500 VDCW, temp coef -80 PPM.
C2	5496267P10	Tantalum: 22 µf ±20%, 15 VDCW; sim to Sprague Type 150D.
C3	19A116080P107	Polyester: 0.1 µf ±10%, 50 VDCW.
C4	19A116080P116	Polyester: 0.0068 µf ±10%, 50 VDCW.
C5	5496267P10	Tantalum: 22 µf ±20%, 15 VDCW; sim to Sprague Type 150D.
C6	5496267P14	Tantalum: 15 µf ±20%, 20 VDCW; sim to Sprague Type 150D.
		- - - - - - - - DIODES AND RECTIFIERS - - - - - -
CR1 thru CR6	19A115845P1	Silicon.
CR7 thru CR13	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
		- - - - - - - JACKS AND RECEPTACLES - - - - - - -
J1 thru J6	19A116659P145	Connector, printed wiring: 8 contacts; sim to Molex 09-75-1081.
J7	19A116659P110	Connector, printed wiring: 11 contacts; sim to Molex 09-60-1111.
J8	19A116659P136	Connector, printed wiring: 5 contacts; sim to Molex 09-75-1054.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L1 thru L6	19B233305G1	Coil.
		- - - - - - - - - - TRANSISTORS - - - - - - - - -
Q1 thru Q6	19A116742P1	Silicon, NPN.
Q7 thru Q12	19A115852P1	Silicon, PNP; sim to Type 2N3906.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	3R152P102J	Composition: 1K ohms ±5%, 1/4 w.
R2	3R152P302J	Composition: 3K ohms ±5%, 1/4 w.
R3	3R152P303J	Composition: 30K ohms ±5%, 1/4 w.
R4	3R152P103J	Composition: 10K ohms ±5%, 1/4 w.
R5	3R152P202J	Composition: 2K ohms ±5%, 1/4 w.
R6	3R152P102J	Composition: 1K ohms ±5%, 1/4 w.
R7	3R152P152J	Composition: 1.5K ohms ±5%, 1/4 w.
R8	3R152P102J	Composition: 1K ohms ±5%, 1/4 w.
R9	3R152P152J	Composition: 1.5K ohms ±5%, 1/4 w.
R10	3R152P102J	Composition: 1K ohms ±5%, 1/4 w.
R11	19C314256P24021	Metal film: 4.02K ohms ±1%, 1/4 w.
R12 and R13	19C314256P23011	Metal film: 3.0K ohms ±1%, 1/4 w.
R14	3R152P102J	Composition: 1K ohms ±5%, 1/4 w.
R15 and R16	3R152P302J	Composition: 3K ohms ±5%, 1/4 w.
R17	3R152P152J	Composition: 1.5K ohms ±5%, 1/4 w.
R18	3R152P102J	Composition: 1K ohms ±5%, 1/4 w.
R19 thru R21	19C314256P24991	Metal film: 4.9K ohms ±1%, 1/4 w.
R22	3R152P102J	Composition: 1K ohms ±5%, 1/4 w.
R23	3R152P562J	Composition: 5.6K ohms ±5%, 1/4 w.
R24	3R152P103J	Composition: 10K ohms ±5%, 1/4 w.
R25 and R26	3R152P104J	Composition: 100K ohms ±5%, 1/4 w.
R27	19C314256P24992	Metal film: 49.9K ohms ±1%, 1/4 w.
R28	19C314256P21472	Metal film: 14.7K ohms ±1%, 1/4 w.
R29	19C314256P21821	Metal film: 1.8K ohms ±1%, 1/4 w.
R30	3R152P221J	Composition: 220 ohms ±5%, 1/4 w.
R31 thru R36	3R152P302J	Composition: 3K ohms ±5%, 1/4 w.
R37 thru R42	3R152P181J	Composition: 180 ohms ±5%, 1/4 w.
R43	19C314256P24992	Metal film: 49.9K ohms ±1%, 1/4 w.
R44	3R152P106J	Composition: 10.0 megohms ±5%, 1/4 w.
R45	19C314256P21002	Metal film: 10K ohms ±1%, 1/4 w.
R46	3R152P102J	Composition: 1K ohms ±5%, 1/4 w.
R47	19C314256P26492	Metal film: 64.9K ohms ±1%, 1/4 w.
R48	19C314256P28452	Metal film: 84.5K ohms ±1%, 1/4 w.
R49	19C314256P21103	Metal film: 110K ohms ±1%, 1/4 w.
R50	19C314256P21473	Metal film: 147K ohms ±1%, 1/4 w.
R51	19A116430P8	Variable, cermet: 10K ohms ±10%, 0.75 w; sim to Helitrim Model 79P.
R52	3R152P331J	Composition: 330 ohms ±5%, 1/4 w.
R53	3R152P153J	Composition: 15K ohms ±5%, 1/4 w.
R54 and R55	3R152P102J	Composition: 1K ohms ±5%, 1/4 w.
R58 thru R63	3R77P361J	Composition: 360 ohms ±5%, 1/2 w.
R64 thru R69	19A700111P41	Composition: 120 ohms ±5%, 2 w.
R70 thru R75	3R152P102J	Composition: 1K ohms ±5%, 1 w.
R76 thru R81	3R152P202J	Composition: 2K ohms ±5%, 1/4 w.
R82 thru R87	3R77P101J	Composition: 100 ohms ±5%, 1/2 w.
R88	19A116559P104	Variable, cermet: 2.5K ohms ±20%, 0.5 w; sim to CTS Series 360.
		- - - - - - - - - - THERMISTORS - - - - - - - - - -
RT1	19C300048P6	Disc: 50K ohms ±10%; sim to NL IND 4D103.
		- - - - - - - - - TERMINAL BOARDS - - - - - - - - -
TB1	7487424P10	Miniature, phen: 2 terminals.
		- - - - - - - - - INTEGRATED CIRCUITS - - - - - - -
U1	19A134782P1	Digital, Outline For 40 Pin Plastic Dip Case: Identification No. 4782P1.
U2	19A134714P2	Digital, Outline For 28 Pin Dip Case: 6505 Microprocessor, plastic package with tin leads.
U3	19A134305P13	Digital, Hex Schmitt-Trigger Inverter: Identification No. 74LS14.
U4	19A134305P35	Digital, Dual D-Type Positive Edge-Triggered: Identification No. 74LS74.
U5	19A134826P1	Silicon, Outline For 16-Pin Dip Case; sim to MC1408L8.
U6	19A134305P111	Digital, Octal D F-F With Clear, Outline For 20-Pin: Identification No. 74LS273.
U7 and U8	19A134305P110	Digital, Triple 3 Input Positive-And Gate: Identification No. 74LS11.
U9	19A116180P56	Digital, Hex Buffers/Drivers w/Open-Collector High Voltage Output: Identification No. 7407.
U10 and U11	19A134097P43	Digital, Single 8-Channel Multiplexer: Identification No. 4051.
U12 and U13	19A134305P1	Digital, Quad 2-Input Positive-Nand Gate: Identification No. 74LS00.
U14	19A116180P56	Digital, Hex Buffers/Drivers w/Open-Collector High Voltage Output: Identification No. 7407.
U15	19A116180P33	Digital, Hex Inverter Buffers/Driver (Open Collector): Identification No. 7416.
U16	19A134305P81	Digital, Synchronous 4-Bit Up/Down Binary Counter: Identification No. 74LS193.
		- - - - - - - - VOLTAGE REGULATORS - - - - - - -
VR1 and VR2	4036887P6	Zener: 500 mW, 6.5 v. nominal.
VR3	19A134936P1	Integrated circuit, linear: sim to T1 TL430C.
		- - - - - - - - - - - SOCKETS - - - - - - - - - -
XU1	19A700156P5	Socket, integrated circuit: 40 positions; sim to Burndy DILB40P-108.or Augat 340-AG39D or AMP 640379-3.
XU2	19A700156P3	Socket, integrated circuit: 28 positions; sim to Burndy DILB28P-108 or Augat 328-AG39D or AMP 640362-3.
A802		BATTERY DISCHARGE BOARD 19C330184G1
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - -
AR1	19A134379P1	Linear, TO-99 CASE; sim to RCA CA3130T.
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C1	19A700105P28	Mica: 56 pf ±5%, 500 VDCW.
		- - - - - - - - DIODES AND RECTIFIERS - - - - - -
CR1	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
		- - - - - - - JACKS AND RECEPTACLES - - - - - - -
J1	19B233306G1	Contact.
		- - - - - - - - - - - PLUGS - - - - - - - - - - -
P8		Connector. Includes:
	19A116659P18	Shell.
	19A116781P5	Contact, electrical: sim to Molex 08-50-0106.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

Parts List Cont'd on page 12


OSCILLATOR
TO U7-4 SH 1
TO U7-5 SH 1
TO U7-6 SH 1
TO U7-7 SH 1
TO U7-9 SH 1
TO U7-10 SH.1
U12-A
U12-B
U12-D
U12-C
U13-A
U13-B
S0
S1
S2
S3
S4
S5
AR2-A
AR2-B
R23 5.6K
C4 .0068
R88 2.5K 1/2W
R24 10K
R25 100K
R26 100K
R27 49.9K
R28 14.7K
R29 1.82K
R30 220
PRECISION REFERENCE
SOURCE V REF
R52 330
C5 22UF 15V
R51 10K
VR3
120 HZ PLUSE GENERATOR
AR1-B
R14 1K
R53 15K
R15 3K
R16 3K
CR13
R5 2K
R6 1K
U3C
U16
C16 15UF
R54 1K
TO U4-3 SH.1
GND
(SH 1)TO AR1-12
(SH 1)TO U7-12
+12V
V REF
J8 P8
A801
PL19D430348G1
TO U10-4 SH.1
POWER SUPPLY
G1 & G2
SEE SH.3 FOR G3 & G4
RT801
+22 VAC SOURCE
GND
+22 V SOURCE
+12 V SOURCE
+5 V SOURCE
-12 V SOURCE
VR801
VR802
VR803
C801 12900 UF
C2 15UF
C3 15UF
C4 15UF
C1 200
CR3
CR4
CR801
CR802
CR1
CR2
A810
PL19C330393G1
W801
P801
J801
F801 XF801
T801
V20-BK
V20-G
V20-R
V20-V
V20-BR
V20-O
V20-BL
V20-Y
V20-GA
G10
+10V REF
+5V
GND
+22V
CR1
CR7
Q1
Q7
R64 120 2W
POSITION 0
L1
H20
H21
J1 P1
DS1
DS2
C1 .005
A804
PL19C328838G3
POSITION 1 ADD 1 TO EACH COMPONENT REF DESIGNATION
POSITION 2 ADD 2 TO EACH COMPONENT REF DESIGNATION
POSITION 3 ADD 3 TO EACH COMPONENT REF DESIGNATION
POSITION 4 ADD 4 TO EACH COMPONENT REF DESIGNATION
POSITITON 5 ADD 5 TO EACH COMPONENT REF DESIGNATION
A805
A806
A807
A808
A809
L2
L3
L4
L5
L6
DISCHARGE RATE
J1 BATT TEST
S1
700 MA
1200 MA
W1
J7 P7
+5 V
TO U6-2
TO U6-5
TO U6-6
TO U6-9
TO U6-12
TO U6-15
TO U6-16
TO U6-19
TO U3-8
SH.1
DS1 (RIGHT DIGIT)
DS1 (LEFT DIGIT)
BATTERY DISCHARGE OPTION
A802
PL19C330184G1
R1 15K
R2 1K
R3 51K
C1 56
AR1-A
R4 1K
Q1
Q801
R5 1K
R6 0.27 2W
TP1

(19D430570, Sh. 2, Rev. 1)

SCHEMATIC DIAGRAM

RAPID 1 MULTI-CHARGER
(Sheet 2)

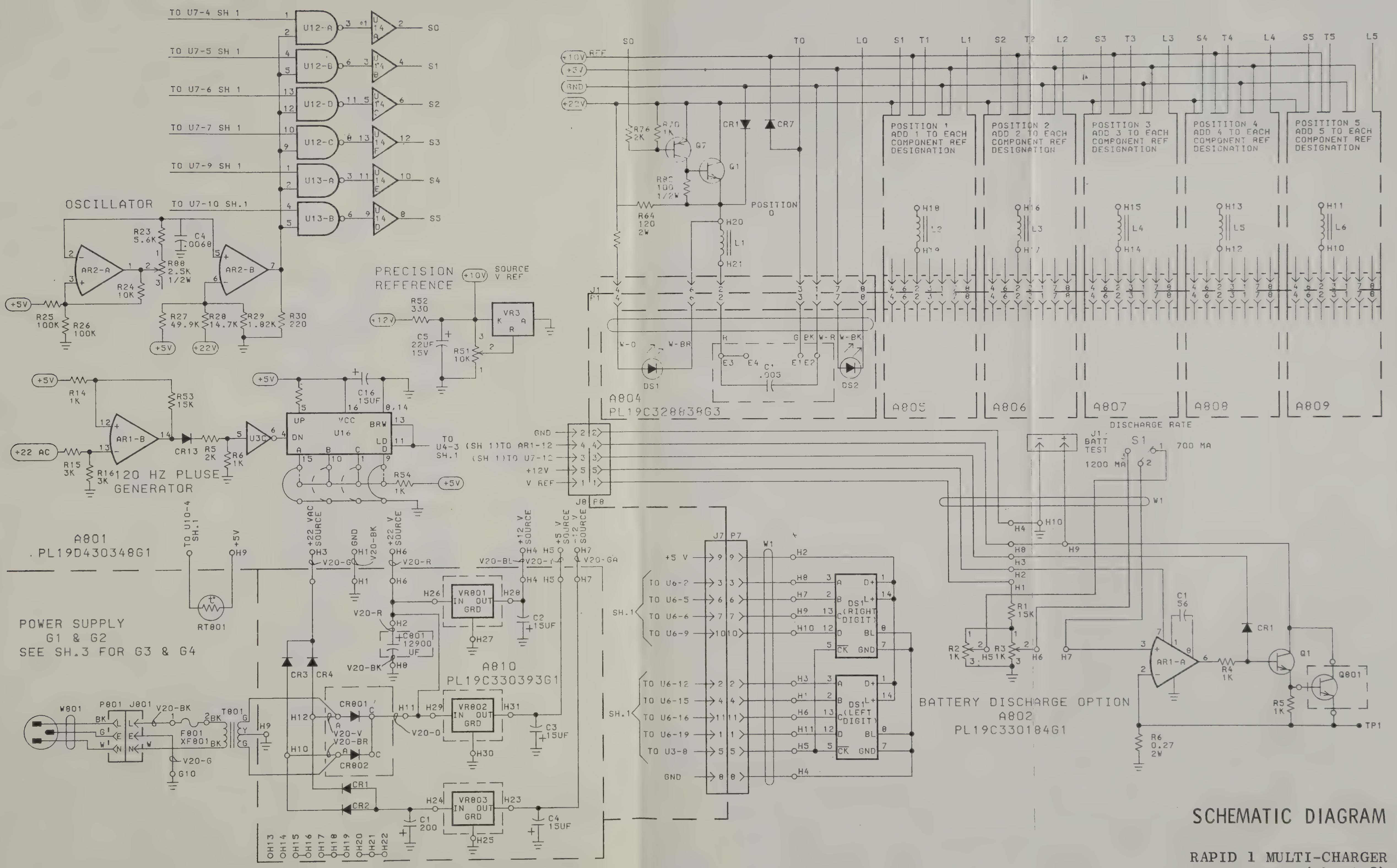
PARTS LIST

MPR 1-HOUR MULTI-CHARGER
19D430514G1 120 V DISCHARGE OPTION
19D430514G2 120 V
19D430514G3 240 V DISCHARGE OPTION
19D430514G4 240 V
ISSUE 1

SYMBOL	GE PART NO.	DESCRIPTION
A801		CHARGER BOARD 19D430348G1
		- - - - - - - - - INTEGRATED CIRCUITS - - - - - - - -
AR1 and AR2	19A134511P1	Linear, Quad OP AMP; sim to NSCLM 224J.
AR3	19A134379P1	Linear, TO-99 CASE; sim to RCA CA3130T.
		- - - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	19A116656P10J8	Ceramic disc: 10 pf ±0.5 pf, 500 VDCW, temp coef -80 PPM.
C2	5496267P10	Tantalum: 22 µf ±20%, 15 VDCW; sim to Sprague Type 150D.
C3	19A116080P107	Polyester: 0.1 µf ±10%, 50 VDCW.
C4	19A116080P116	Polyester: 0.0068 µf ±10%, 50 VDCW.
C5	5496267P10	Tantalum: 22 µf ±20%, 15 VDCW; sim to Sprague Type 150D.
C6	5496267P14	Tantalum: 15 µf ±20%, 20 VDCW; sim to Sprague Type 150D.
		- - - - - - - - - DIODES AND RECTIFIERS - - - - - - -
CR1 thru CR6	19A115845P1	Silicon.
CR7 thru CR13	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
		- - - - - - - - JACKS AND RECEPTACLES - - - - - - - -
J1 thru J6	19A116659P145	Connector, printed wiring: 8 contacts; sim to Molex 09-75-1081.
J7	19A116659P110	Connector, printed wiring: 11 contacts; sim to Molex 09-60-1111.
J8	19A116659P136	Connector, printed wiring: 5 contacts; sim to Molex 09-75-1054.
		- - - - - - - - - - - INDUCTORS - - - - - - - - - - -
L1 thru L6	19B233305G1	Coil.
		- - - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q1 thru Q6	19A116742P1	Silicon, NPN.
Q7 thru Q12	19A115852P1	Silicon, PNP; sim to Type 2N3906.
		- - - - - - - - - - - RESISTORS - - - - - - - - - - -
R1	3R152P102J	Composition: 1K ohms ±5%, 1/4 w.
R2	3R152P302J	Composition: 3K ohms ±5%, 1/4 w.
R3	3R152P303J	Composition: 30K ohms ±5%, 1/4 w.
R4	3R152P103J	Composition: 10K ohms ±5%, 1/4 w.
R5	3R152P202J	Composition: 2K ohms ±5%, 1/4 w.
R6	3R152P102J	Composition: 1K ohms ±5%, 1/4 w.
R7	3R152P152J	Composition: 1.5K ohms ±5%, 1/4 w.
R8	3R152P102J	Composition: 1K ohms ±5%, 1/4 w.
R9	3R152P152J	Composition: 1.5K ohms ±5%, 1/4 w.
R10	3R152P102J	Composition: 1K ohms ±5%, 1/4 w.
R11	19C314256P24021	Metal film: 4.02K ohms ±1%, 1/4 w.
R12 and R13	19C314256P23011	Metal film: 3.0K ohms ±1%, 1/4 w.
R14	3R152P102J	Composition: 1K ohms ±5%, 1/4 w.
R15 and R16	3R152P302J	Composition: 3K ohms ±5%, 1/4 w.
R17	3R152P152J	Composition: 1.5K ohms ±5%, 1/4 w.
R18	3R152P102J	Composition: 1K ohms ±5%, 1/4 w.
R19 thru R21	19C314256P24991	Metal film: 4.9K ohms ±1%, 1/4 w.
R22	3R152P102J	Composition: 1K ohms ±5%, 1/4 w.
R23	3R152P562J	Composition: 5.6K ohms ±5%, 1/4 w.
R24	3R152P103J	Composition: 10K ohms ±5%, 1/4 w.
R25 and R26	3R152P104J	Composition: 100K ohms ±5%, 1/4 w.
R27	19C314256P24992	Metal film: 49.9K ohms ±1%, 1/4 w.
R28	19C314256P21472	Metal film: 14.7K ohms ±1%, 1/4 w.
R29	19C314256P21821	Metal film: 1.8K ohms ±1%, 1/4 w.
R30	3R152P221J	Composition: 220 ohms ±5%, 1/4 w.
R31 thru R36	3R152P302J	Composition: 3K ohms ±5%, 1/4 w.
R37 thru R42	3R152P181J	Composition: 180 ohms ±5%, 1/4 w.
R43	19C314256P24992	Metal film: 49.9K ohms ±1%, 1/4 w.
R44	3R152P106J	Composition: 10.0 megohms ±5%, 1/4 w.
R45	19C314256P21002	Metal film: 10K ohms ±1%, 1/4 w.
R46	3R152P102J	Composition: 1K ohms ±5%, 1/4 w.
R47	19C314256P26492	Metal film: 64.9K ohms ±1%, 1/4 w.
R48	19C314256P28452	Metal film: 84.5K ohms ±1%, 1/4 w.
R49	19C314256P21103	Metal film: 110K ohms ±1%, 1/4 w.
R50	19C314256P21473	Metal film: 147K ohms ±1%, 1/4 w.
R51	19A116430P8	Variable, cermet: 10K ohms ±10%, 0.75 w; sim to Helitrim Model 79P.
R52	3R152P331J	Composition: 330 ohms ±5%, 1/4 w.
R53	3R152P153J	Composition: 15K ohms ±5%, 1/4 w.
R54 and R55	3R152P102J	Composition: 1K ohms ±5%, 1/4 w.
R58 thru R63	3R77P361J	Composition: 360 ohms ±5%, 1/2 w.
R64 thru R69	19A700111P41	Composition: 120 ohms ±5%, 2 w.
R70 thru R75	3R152P102J	Composition: 1K ohms ±5%, 1 w.
R76 thru R81	3R152P202J	Composition: 2K ohms ±5%, 1/4 w.
R82 thru R87	3R77P101J	Composition: 100 ohms ±5%, 1/2 w.
R88	19A116559P104	Variable, cermet: 2.5K ohms ±20%, 0.5 w; sim to CTS Series 360.
		- - - - - - - - - - THERMISTORS - - - - - - - - - -
RT1	19C300048P6	Disc: 50K ohms ±10%; sim to NL IND 4D103.
		- - - - - - - - - TERMINAL BOARDS - - - - - - - - - -
TB1	7487424P10	Miniature, phen: 2 terminals.
		- - - - - - - - - INTEGRATED CIRCUITS - - - - - - - -
U1	19A134782P1	Digital, Outline For 40 Pin Plastic Dip Case: Identification No. 4782P1.
U2	19A134714P2	Digital, Outline For 28 Pin Dip Case: 6505 Microprocessor, plastic package with tin leads.
U3	19A134305P13	Digital, Hex Schmitt-Trigger Inverter: Identification No. 74LS14.
U4	19A134305P35	Digital, Dual D-Type Positive Edge-Triggered: Identification No. 74LS74.
U5	19A134826P1	Silicon, Outline For 16-Pin Dip Case; sim to MC1408L8.
U6	19A134305P111	Digital, Octal D F-F With Clear, Outline For 20-Pin: Identification No. 74LS273.
U7 and U8	19A134305P110	Digital, Triple 3 Input Positive-And Gate: Identification No. 74LS11.
U9	19A116180P56	Digital, Hex Buffers/Drivers w/Open-Collector High Voltage Output: Identification No. 7407.
U10 and U11	19A134097P43	Digital, Single 8-Channel Multiplexer: Identification No. 4051.
U12 and U13	19A134305P1	Digital, Quad 2-Input Positive-Nand Gate: Identification No. 74LS00.
U14	19A116180P56	Digital, Hex Buffers/Drivers w/Open-Collector High Voltage Output: Identification No. 7407.
U15	19A116180P33	Digital, Hex Inverter Buffers/Driver (Open Collector): Identification No. 7416.
U16	19A134305P81	Digital, Synchronous 4-Bit Up/Down Binary Counter: Identification No. 74LS193.
		- - - - - - - - - VOLTAGE REGULATORS - - - - - - - -
VR1 and VR2	4036887P6	Zener: 500 mW, 6.5 v. nominal.
VR3	19A134936P1	Integrated circuit, linear: sim to T1 TL430C.
		- - - - - - - - - - - - SOCKETS - - - - - - - - - - -
XU1	19A700156P5	Socket, integrated circuit: 40 positions; sim to Burndy DILB40P-108.or Augat 340-AG39D or AMP 640379-3.
XU2	19A700156P3	Socket, integrated circuit: 28 positions; sim to Burndy DILB28P-108 or Augat 328-AG39D or AMP 640362-3.
A802		BATTERY DISCHARGE BOARD 19C330184G1
		- - - - - - - - - INTEGRATED CIRCUITS - - - - - - - -
AR1	19A134379P1	Linear, TO-99 CASE; sim to RCA CA3130T.
		- - - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	19A700105P28	Mica: 56 pf ±5%, 500 VDCW.
		- - - - - - - - - DIODES AND RECTIFIERS - - - - - - -
CR1	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
		- - - - - - - - JACKS AND RECEPTACLES - - - - - - - -
J1	19B233306G1	Contact.
		- - - - - - - - - - - - PLUGS - - - - - - - - - - - -
P8		Connector. Includes:
	19A116659P18	Shell.
	19A116781P5	Contact, electrical: sim to Molex 08-50-0106.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

Parts List Cont'd on page 12


OSCILLATOR
PRECISION REFERENCE
SOURCE V REF
120 HZ PLUSE GENERATOR
A801
PL19D430348G1
POWER SUPPLY
G1 & G2
SEE SH.3 FOR G3 & G4
A810
PL19C330393G1
A804
PL19C328838G3
A805
A806
A807
A808
A809
POSITION 0
POSITION 1 ADD 1 TO EACH COMPONENT REF DESIGNATION
POSITION 2 ADD 2 TO EACH COMPONENT REF DESIGNATION
POSITION 3 ADD 3 TO EACH COMPONENT REF DESIGNATION
POSITION 4 ADD 4 TO EACH COMPONENT REF DESIGNATION
POSITION 5 ADD 5 TO EACH COMPONENT REF DESIGNATION
DISCHARGE RATE
BATT TEST
700 MA
1200 MA
BATTERY DISCHARGE OPTION
A802
PL19C330184G1
DS1 (RIGHT DIGIT)
DS1 (LEFT DIGIT)
TO U7-4 SH 1
TO U7-5 SH 1
TO U7-6 SH 1
TO U7-7 SH 1
TO U7-9 SH 1
TO U7-10 SH.1
TO U4-3 SH.1
(SH 1)TO AR1-12
(SH 1)TO U7-12
TO U6-7
TO U6-5
TO U6-6
TO U6-9
TO U6-12
TO U6-15
TO U6-16
TO U6-19
TO U3-8
S0
S1
S2
S3
S4
S5
T0
L0
T1
L1
T2
L2
T3
L3
T4
L4
T5
L5
TP1

SCHEMATIC DIAGRAM

RAPID 1 MULTI-CHARGER
(Sheet 2)

(19D430570, Sh. 2, Rev. 1)

ION

JPPLY
120 VOLT
240 VOLT

(BOARD
3G1

DRS - - - - - - - - - -

% -10%, 18 VDCW; sim

VDCW; sim to Sprague

RECTIFIERS - - - - - -

25 mA, 50 PIV.

ITORS - - - - - - - - -

-100% -10%, 40 VDCW; sim

RECTIFIERS - - - - - - -

13.

ES - - - - - - - - - -

50 v; sim to Bussmann

ECEPTACLES - - - - - -

im to Molex 15-04-0703.

ISTORS - - - - - - - - -

FORMERS - - - - - - - - -

e of CT (no load).

ULATORS - - - - - - - -

r; sim to µA7812U.

r; sim to µA7805U.

r; sim to µA7912U.

TS - - - - - - - - - -

50 v; sim to Littelfuse

ter 031.1657.

ED PARTS

LES - - - - - - - - - -

rox 26-1/2 inches long,
rminal.

contacts.

PARTS
937)

d with Q1-Q6 on A801).

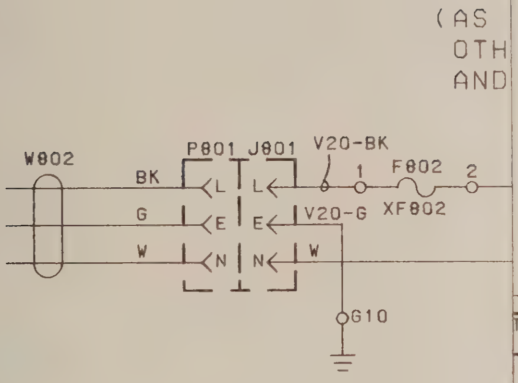
with Q801).

x 7/16. (Secures Q801).

ures Q1-Q6 on A801 &

SYMBOL	GE PART NO.	DESCRIPTION
5	N404P11C6	Lockwasher, internal tooth: No. 4. (Secures Q1-Q6 on A801 & Q801).
6	N402P35C6	Flatwasher: No. 4. (Secures Q1-Q6 on A801 & Q801).
7	4036555P1	Insulator, washer: nylon. (Used with Q1 on A802).
8	19B233062G1	Base assembly.
9	7150186P107	Spacer, sleeving.
10	19B233413G1	Heat sink.
11	19B201074P306	Tap screw, Phillips POZIDRIV®: No. 6-32 x 3/8.
12	19A134796P4	Fuseholder: sim to Schurter 031.1663.
13	19A134796P5	Nut, white plastic.
14	4029851P27	Clip loop.
15	19C330295G1	Cover.
16	19A142819P1	Insulator.
17	19B209268P106	Terminal, solderless: sim to AMP 41184.
18	19A134783P1	Contact, electrical; sim to Molex No. 16-02-1102. (Quantity 3- located on J801).
19	19B233255P1	Support. (C801).
20	19A115185P9	Retainer strap; sim to Dennison BAR-LOK 08471. (C801).
21	4034499P1	Insulator. (Used with L1-L6 on A801).
22	19A116023P3	Insulator, plate. (Used with Q1-Q6 on A801).
23	N80P9006C6	Machine screw: No. 4-40 x 3/8. (Secures Q1-Q6 on A801).
24	19B201074P305	Tap screw, Phillips POZIDRIV®: No. 6-32 x 5/16. (Secures A801).
25	N80P9004C6	Machine screw: No. 4-40 x 1/4.
26	7142162P20	Spacer, hex: No. 4-40. (Secures TB1).
27	4037559P9	Bumper, rubber.
28	N210P15C6	Nut, hex: No. 8-32. (Secures rubber bumpers, item 1).
29	N403P16C6	Lockwasher, external tooth: No. 8. (Secures rubber bumpers).
30	19C330308G1	Chassis. (Discharge option).
31	19C328758G2	Chassis. (Without Discharge option).
32	19A134403P4	Cable clip. (Quantity 2).
33	NP280762	Nameplate. (DISCHARGE RATE).
34	N84P5007C6	Machine screw, flathead: No. 2-56 x 7/16.
35	19D413467P1	Fastener.
36	19A142573P1	Window.
37	7150186P4	Spacer, sleeve.
38	NP280667P1	Nameplate.
39	19A134521P3	Lens, panel light: amber.
40	19A134521P2	Lens, panel light: green.
41	NP280667P4	Nameplate. (RAPID ONE).
42	19B209572P2	Identification plate. (GENERAL ELECTRIC).
43	19C307038P7	Nut, push on; sim to Palnut PS094032. (Secures GE identification plate).

(RC-3937 cont'd on page 14)



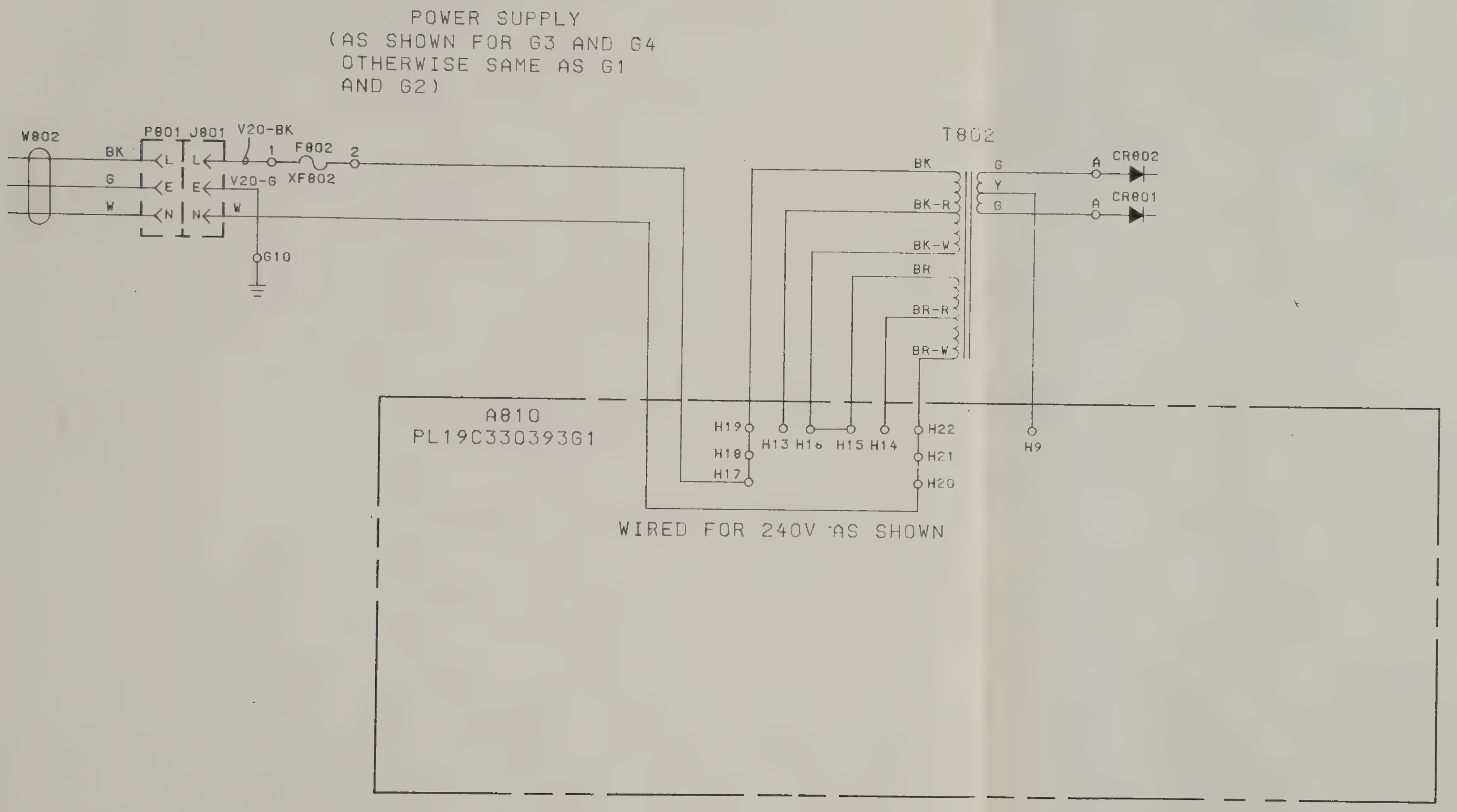
T AC	FROM	TO	WIRE	FUSE
			PART OF	
	T802-BK	A810-H19	T802	
	T802-BK/R	A810-H22	T802	
	T802-BR	A810-H18	T802	
	T802-BR/R	A810-H15	T802	
	F802-2	A810-H17	V20-BK	
	J801-N	A810-H20	V20-W	
			PART OF	
	T802-BK/W	A810-H13	T802	
	T802-BR/W	A810-H14	T802	
			PART OF	
	T802-BK	A810-H19	T802	
	T802-BR	A810-H18	T802	
	T802-BK/W	A810-H22	T802	
	T802-BR/W	A810-H15	T802	
	T802-BK/R	A810-H13	T802	
	T802-BR/R	A810-H14	T802	
	F802-2	A810-H17	V20-BK	
	J801-N	A810-H20	V20-W	
			PART OF	
	T802-BK/R	A810-H15	T802	
	T802-BR	A810-H16	T802	
	T802-BK	A810-H19	T802	
	T802-BR/R	A810-H22	T802	
	T802-BK/W	A810-H13	T802	
	T802-BR/W	A810-H14	T802	
	F802-2	A810-H17	V20-BK	
	J801-N	A810-H20	V20-W	
			PART OF	
	T802-BK	A810-H19	T802	
	T802-BK/R	A810-H13	T802	
	T802-BK/W	A810-H16	T802	
	T802-BR	A810-H15	T802	
	T802-BR/R	A810-H14	T802	
	T802-BR/W	A810-H22	T802	
	F802-2	A810-H17	V20-BK	
	J801-N	A810-H20	V20-W	

SCHEMATIC DIAGRAM

RAPID 1 MULTI-CHARGER
(Sheet 3)

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - TRANSISTORS - - - -
Q1	19A115300P1	Silicon, NPN; sim to Type 2N3053.
		- - - - RESISTORS - - - -
R1	3R152P153J	Composition: 15K ohms ±5%, 1/4 w.
R2 and R3	19A116430P5	Variable, cermet: 1000 ohms ±10%, 0.75 w; sim to Helitrim Model 79P.
R4 and R5	3R152P102J	Composition: 1K ohms ±5%, 1/4 w.
R6	19B209022P101	Wirewound: 0.27 ohms ±10%, 2 w; sim to IRC Type BWH.
		- - - - SWITCHES - - - -
S1	19A116648P6	Toggle: SPDT; sim to C & K Components 7101SDG.
		- - - - TEST POINTS - - - -
TP1	19B211379P1	Spring (Test Point).
		- - - - CABLES - - - -
W1		CABLE ASSEMBLY 19C330184G2 (Includes J1, P8, & S1)
A803		DISPLAY OPTION BOARD 19B233309G1
		- - - - INDICATING DEVICES - - - -
DS1 and DS2	19A134818P1	Display, optoelectronic: red; sim to TIL311.
		- - - - PLUGS - - - -
P7		Connector. Includes:
	19A116659P124	Shell.
	19A116781P6	Contact, electrical; sim to Molex 08-50-0108.
		- - - - CABLES - - - -
W1	19B233309G2	Display Option Component Board. (Inludes P7).
A804 thru A809		SLEEVE ASSEMBLY 19C328838G3
		- - - - CAPACITORS - - - -
C1	5494481P26	Ceramic disc: 5000 pf ±10%, 1000 VDCW; sim to
		- - - - TERMINALS - - - -
E1 thru E4		Contact. Includes:
	19C327044P1	Contact, spring.
	N136P503C	Tap screw: No. 2-32 x 3/16.
		- - - - CABLES - - - -
W1		CABLE ASSEMBLY 19B233104G1
		- - - - INDICATING DEVICES - - - -
DS1	19A134354P2	Diode, optoelectronic: yellow; sim to Hew. Packard 5082-4555.
DS2	19A134354P3	Diode, optoelectronic: green; sim to Hew Packard 5082-4955.
		- - - - PLUGS - - - -
P1		Connector. Includes:
	19A116659P20	Shell.
	19A116781P6	Contact, electrical: sim to Molex 08-50-0108.
		- - - - TRANSISTORS - - - -
Q801	19A116118P1	Silicon, NPN.
		POWER SUPPLY 19D430705G1 120 VOLT 19D430705G2 240 VOLT
A810		POWER SUPPLY BOARD 19C330393G1
		- - - - CAPACITORS - - - -
C1	19A115680P10	Electrolytic: 200 µf +150% -10%, 18 VDCW; sim to Mallory Type TTX.
C2 thru C4	5496267P14	Tantalum: 15 µf ±20%, 20 VDCW; sim to Sprague Type 150D.
		- - - - DIODES AND RECTIFIERS - - - -
CR1 and CR2	4037822P1	Silicon, 1000 mA, 400 PIV.
CR3 and CR4	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
		- - - - CAPACITORS - - - -
C801	5496520P21	Electrolytic: 12,900 µf +100% -10%, 40 VDCW; sim GE 86F159M.
		- - - - DIODES AND RECTIFIERS - - - -
CR801 and CR802	19A115202P1	Silicon; sim to Type 1N1613.
		- - - - FUSES - - - -
F801	7487942P5	Slow blowing: 1 amp at 250 v; sim to Bussmann MDL-1.
		- - - - JACKS AND RECEPTACLES - - - -
J801	19A134784P1	Connector, receptacle: sim to Molex 15-04-0703.
		- - - - THERMISTORS - - - -
RT801	19A142671G1	Thermistor.
		- - - - TRANSFORMERS - - - -
T801	19A116218P4	Power, step-down: Pri: 117 VRMS, 50/60 Hz, Sec: 15.25 VRMS each side of CT (no load).
		- - - - VOLTAGE REGULATORS - - - -
VR801	19A134717P2	Integrated circuit, linear; sim to µA7812U.
VR802	19A134717P1	Integrated circuit, linear; sim to µA7805U.
VR803	19A134718P2	Integrated circuit, linear; sim to µA7912U.
		- - - - SOCKETS - - - -
XF801	4037402P1	Fuseholder: 15 amps at 250 v; sim to Littelfuse 34100J.
XF802	19A134796P2	Fuseholder: sim to Schurter 031.1657.
		ASSOCIATED PARTS
		- - - - CABLES - - - -
W801	19A134713P1	Cable, power: black; approx 26-1/2 inches long, includes 19B209268P113 terminal.
W802	19A134713P2	Cable, power: 2 poles, 3 contacts.
		MECHANICAL PARTS (SEE RC3937)
1	19A134016P1	Insulator, bushing. (Used with Q1-Q6 on A801).
2	19A116023P1	Insulator, plate. (Used with Q801).
3	N80P9007C6	Machine screw: No. 4-40 x 7/16. (Secures Q801).
4	7141225P2	Hex nut: No. 4-40. (Secures Q1-Q6 on A801 & Q801).
5	N404P11C6	Lockwasher, internal tooth: No. 4. (Secures Q1-Q6 on A801 & Q801).
6	N402P35C6	Flatwasher: No. 4. (Secures Q1-Q6 on A801 & Q801).
7	4036555P1	Insulator, washer: nylon. (Used with Q1 on A802).
8	19B233062G1	Base assembly.
9	7150186P107	Spacer, sleeving.
10	19B233413G1	Heat sink.
11	19B201074P306	Tap screw, Phillips POZIDRIV®: No. 6-32 x 3/8.
12	19A134796P4	Fuseholder: sim to Schurter 031.1663.
13	19A134796P5	Nut, white plastic.
14	4029851P27	Clip loop.
15	19C330295G1	Cover.
16	19A142819P1	Insulator.
17	19B209268P106	Terminal, solderless: sim to AMP 41184.
18	19A134783P1	Contact, electrical; sim to Molex No. 16-02-1102. (Quantity 3- located on J801).
19	19B233255P1	Support. (C801).
20	19A115185P9	Retainer strap; sim to Dennison BAR-LOK 08471. (C801).
21	4034499P1	Insulator. (Used with L1-L6 on A801).
22	19A116023P3	Insulator, plate. (Used with Q1-Q6 on A801).
23	N80P9006C6	Machine screw: No. 4-40 x 3/8. (Secures Q1-Q6 on A801).
24	19B201074P305	Tap screw, Phillips POZIDRIV®: No. 6-32 x 5/16. (Secures A801).
25	N80P9004C6	Machine screw: No. 4-40 x 1/4.
26	7142162P20	Spacer, hex: No. 4-40. (Secures TB1).
27	4037559P9	Bumper, rubber.
28	N210P15C6	Nut, hex: No. 8-32. (Secures rubber bumpers, item 1).
29	N403P16C6	Lockwasher, external tooth: No. 8. (Secures rubber bumpers).
30	19C330308G1	Chassis. (Discharge option).
31	19C328758G2	Chassis. (Without Discharge option).
32	19A134403P4	Cable clip. (Quantity 2).
33	NP280762	Nameplate. (DISCHARGE RATE).
34	N84P5007C6	Machine screw, flathead: No. 2-56 x 7/16.
35	19D413467P1	Fastener.
36	19A142573P1	Window.
37	7150186P4	Spacer, sleeve.
38	NP280667P1	Nameplate.
39	19A134521P3	Lens, panel light: amber.
40	19A134521P2	Lens, panel light: green.
41	NP280667P4	Nameplate. (RAPID ONE).
42	19B209572P2	Identification plate. (GENERAL ELECTRIC).
43	19C307038P7	Nut, push on; sim to Palnut PS094032. (Secures GE identification plate).

(RC-3937 cont'd on page 14)


POWER SUPPLY
(AS SHOWN FOR G3 AND G4
OTHERWISE SAME AS G1
AND G2)
W802
BK
G
W
P801
J801
L
E
N
V20-BK
V20-G
W
1
F802
2
XF802
G10
T802
BK
BK-R
BK-W
BR
BR-R
BR-W
G
Y
G
A
CR802
A
CR801
A810
PL19C330393G1
H19
H18
H17
H13
H16
H15
H14
H22
H21
H20
H9
WIRED FOR 240V AS SHOWN

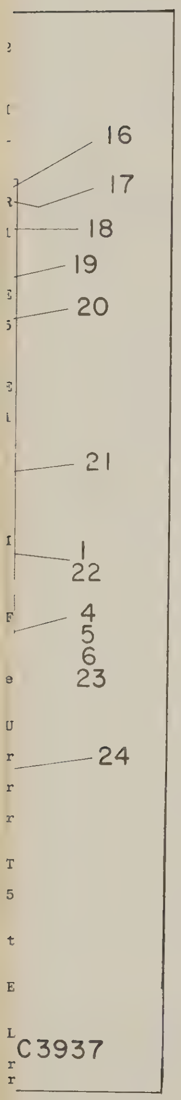
(19D430570, Sh. 3, Rev. 1)

CONNECTION CHART

INPUT VOLTS AC	FROM	TO	WIRE	FUSE
105			PART OF	
	T802-BK	A810-H19	T802	
	T802-BK/R	A810-H22	T802	
	T802-BR	A810-H18	T802	
	T802-BR/R	A810-H15	T802	
	F802-2	A810-H17	V20-BK	
	J801-N	A810-H20	V20-W	
			PART OF	
	T802-BK/W	A810-H13	T802	
	T802-BR/W	A810-H14	T802	
120			PART OF	
	T802-BK	A810-H19	T802	
	T802-BR	A810-H18	T802	
	T802-BK/W	A810-H22	T802	
	T802-BR/W	A810-H15	T802	
	T802-BK/R	A810-H13	T802	
	T802-BR/R	A810-H14	T802	
	F802-2	A810-H17	V20-BK	
	J801-N	A810-H20	V20-W	
210			PART OF	
	T802-BK/R	A810-H15	T802	
	T802-BR	A810-H16	T802	
	T802-BK	A810-H19	T802	
	T802-BR/R	A810-H22	T802	
	T802-BK/W	A810-H13	T802	
	T802-BR/W	A810-H14	T802	
	F802-2	A810-H17	V20-BK	
	J801-N	A810-H20	V20-W	
240			PART OF	
	T802-BK	A810-H19	T802	
	T802-BK/R	A810-H13	T802	
	T802-BK/W	A810-H16	T802	
	T802-BR	A810-H15	T802	
	T802-BR/R	A810-H14	T802	
	T802-BR/W	A810-H22	T802	
	F802-2	A810-H17	V20-BK	
	J801-N	A810-H20	V20-W	

SCHEMATIC DIAGRAM

RAPID 1 MULTI-CHARGER
(Sheet 3)


C3937

t similarly

f the following sections are at fault since
lure would affect all sleeves alike.

A. CHARGER +5V.

1. Che 0 volts.

2. Che 1-A, AR3, VR1, VR2 and associated components.

3. Kno andard resistors R43-R50.

B. CHARGER

1. No onents.

a.

ugh U8 only affects the GREEN LED's.

ot similar

tiple failures or the inability of the micro-
sleeve.

, including U7 thru 11 and R31-36, should be
minate nodes.

ower supplies may contribute to such illogi-

usted 10.00 volt reference may cause this

b.

c. ROUPS WHICH CAUSE THEM

tery is placed in a sleeve.

onents R64, R65, DS1, J1/P1 or the battery

d. the +22 volt power supply is at fault.

delay charging should commence. You may use
rrent or simply listen for a squeal from the
.

following may have occurred:

rickle charge current cannot bring the volt-

charger is below 0° C or above 55° C and the
ging.

e.

l is beyond allowable limits and the micro-

al. Check AR2 pin 5 for a triangle wave and

f.

g. bable that the microprocessor and associated

2. One
It i
oper tting and 0.324 for 1200 mA.

a.

b.

c. ll connections are good, replace DS1 or DS2

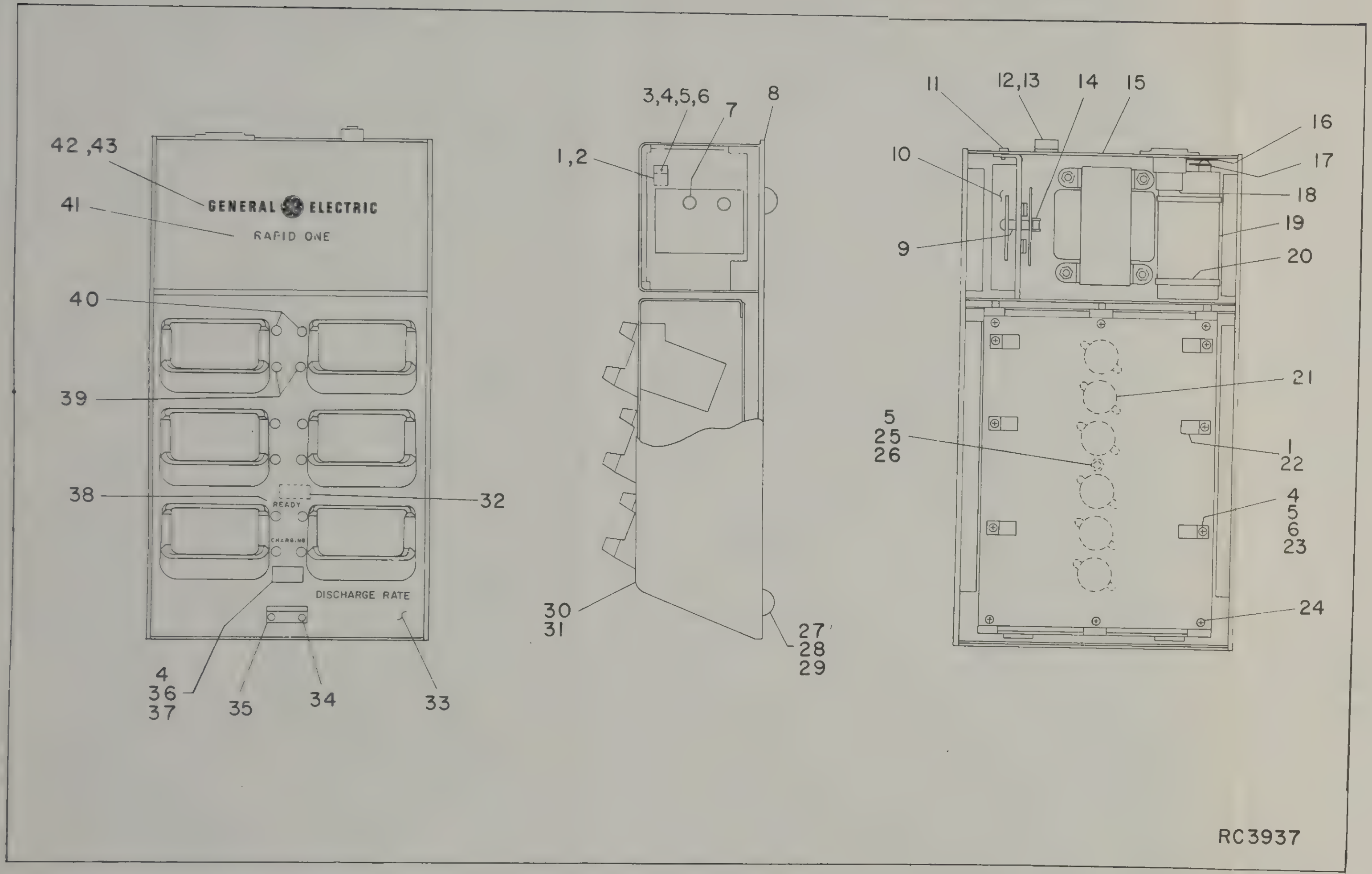
d.

e.

f.

g.

TROUBLESHOOTING PROCEDURE


42,43
41
GENERAL ELECTRIC
RAPID ONE
40
39
38
READY
CHARGING
32
DISCHARGE RATE
4
36
37
35
34
33
1,2
3,4,5,6
7
8
30
31
27
28
29
11
12,13
14
15
16
17
18
19
20
10
9
21
5
25
26
1
22
4
5
6
23
24
RC3937

TROUBLESHOOTING PROCEDURE

A. CHARGER COMPLETELY DEAD:

1. Check fuse F801
2. Check line voltage
3. Known good battery pack

B. CHARGER MALFUNCTIONS

1. No sleeve functions properly

    a. Check power supplies:

    +22V source at H6

    +12V source at H4

    +5 V source at H5

    -12V source at H7

    If any supply voltage is wrong, (+22 is unreg) disconnect the load and retry. The regulators UR801-803 are designed to shut down on overcurrent or over-temperature so if normal supply voltage returns with no load, the problem may well be on main board A801. Notwithstanding direct shorts, the offending component will likely be quite hot.

    If supplies are OK:

    b. Check the 10.00 volt reference at VR3(K). Must be accurately w/R51.

    c. Check the microprocessor clock at U1 pin 3. Must be a near square-wave at 0.7-1.0 MHz, TTL LEVEL. Frequency is not critical but should not exceed 1.0 MHz.

    If bad, remove U1 and retest.
    Check U2, U3, R3, C1.

    d. If the clock is OK, perform a cursory test of the microprocessor by observing the INTERRUPT SERVICE FLIP-FLOP U4a.

    U4a pin 3 should have a low frequency TTL pulse whose leading edge 5 causes pin 5 to go low supplying an IRQ signal to U2 pin 4.

    The microprocessor should reply to this input by driving U2 pin 21 low and then high, which in turn sets U4a to its original state.

    While this test does not completely confirm that U1 and U2 are good, the probability is high, since in order for this to succeed, a lot of things have to happen right!

    e. If this test fails, observe the 20 address and data leads between U1 and U2, using an oscilloscope.

    None should be stuck high or low and none should have voltages other than normal TTL levels, i.e., ≤0.4V or ≥2.4V.

    Watch for identical patterns on adjacent runs. They may indicate shorts.

    f. Check the System Reset pulse on U2 pin 1, U1 pin 16, U8 and U7 pin 15. It must go low when power is applied and return high several milliseconds later.

    g. Check U3, R4, C2 if not.

2. One or more sleeves function properly while others do not

    It is probably true that the following sections are not at fault since the proper operation of at least one sleeve indicates they are operating properly.

    a. Microprocessor section U1 thru U4.

    b. Voltage Reference VR3.

    c. D-A convertor U5 and associated AR1-A, AR3, and VR1, VR2.

    d. Temperature sensor RT1, 801 and standard resistors R43-R50.

    e. Analog multiplexer U11 but not U10.

    f. Oscillator AR2 and associated components.

    g. Power supplies

3. No sleeve functions and all sleeves act similarly

    It is probably true that one or more of the following sections are at fault since their operation is essential and a failure would affect all sleeves alike.

    a. Power supplies +22, + and -12 and +5V.

    b. Voltage Reference AR3 must be 10.00 volts.

    c. D-A Convertor U5 and associated AR1-A, AR3, VR1, VR2 and associated components.

    d. Temperature sensor RT1, 801 and standard resistors R43-R50.

    e. Analog multiplexers U10 and U11.

    f. Oscillator AR2 and associated components.

    g. Microprocessor section U1-U4.

    h. Addressable latches U7 or U8 although U8 only affects the GREEN LED's.

    i. Level shifter U9.

4. No sleeve functions and failures are not similar

    This unlikely mode may result from multiple failures or the inability of the microprocessor to individually address each sleeve.

    a. The circuit from U6, all Q outputs, including U7 thru 11 and R31-36, should be free of floating, stuck or indeterminate nodes.

    b. One or more oscillating or noisy power supplies may contribute to such illogical failures.

    c. A noisy, oscillating or poorly adjusted 10.00 volt reference may cause this also.

C. SPECIFIC PROBLEM TYPES AND THE COMPONENT GROUPS WHICH CAUSE THEM

1. Yellow LED should light whenever a battery is placed in a sleeve.

    a. If a single sleeve fails, the components R64, R65, DS1, J1/P1 or the battery may be at fault.

    b. If all sleeves are defective, then the +22 volt power supply is at fault.

2. On inserting a battery, after a short delay charging should commence. You may use a charger calibrator to measure the current or simply listen for a squeal from the pot-cores in the current limit circuit.

    If charging fails to start, one of the following may have occurred:

    a. The battery is defective and the trickle charge current cannot bring the voltage above 7.2V.

    b. The temperature at RT1 inside the charger is below 0°C or above 55°C and the microprocessor will not allow charging.

    c. The transformer temperature of 7801 is beyond allowable limits and the microprocessor will not allow charging.

    d. The oscillator AR2 is not functional. Check AR2 pin 5 for a triangle wave and pin 7 for a TTL level pulse.

D. DISCHARGE OPTION MALFUNCTIONS

1. If all other functions work, it is probable that the microprocessor and associated circuitry is okay.
2. Check connections in P7 and 8.
3. A802 H7 should be 0.189V for 700 mA setting and 0.324 for 1200 mA.
4. P8-3 should be a logical 1.
5. Check AR1, Q1 and Q801.
6. If the display does not function and all connections are good, replace DS1 or DS2 that is defective.

APPENDIX

```
*****************************************************************************
*                                                                           *
*  USER DOCUMENT: MPR ONE HOUR MULTI-CHARGER 06 JUN 79 R.J.MARTIN           *
*                                                                           *
*****************************************************************************
```

I. HARDWARE DESCRIPTION

A. GENERAL

HARDWARE CONTROLLED BY THE MICROPROCESSOR IS USED TO CONTROL THE CHARGING CURRENT FOR SIX BATTERIES. ONE L.E.D. INDICATOR IS ASSOCIATED WITH EACH. A SEVENTH BATTERY MAY BE DISCHARGED TO A FIXED VOLTAGE WHILE THE TIME REQUIRED TO SO IS RECORDED AND DISPLAYED EITHER AS PERCENTAGE OF FULL CHARGE OR AS MINUTES.

TO DETERMINE THE CORRECT AND SAFE CHARGING CYCLE, HARDWARE IS CONTROLLED BY THE MICROPROCESSOR TO MULTIPLEX VOLTAGE AND TEMPERATURE DATA FROM EACH BATTERY TO A SINGLE COMPARATOR WHICH TESTS THE BATTERY DATA AGAINST A SINGLE TEST VOLTAGE GENERATED BY AN A TO D CONVERTER ALSO DRIVEN BY THE MICROPROCESSOR. RESULTS ARE RETURNED TO A SINGLE INPUT FOR ANALYSIS. TWO OTHER INPUTS AND COMPARATORS ARE USED TO DETERMINE THE STATE OF THE BATTERY DISCHARGING SOCKET. THE RECTIFIED POWER LINE FREQUENCY IS USED TO INTERRUPT THE MICROPROCESSOR FOR THE PURPOSE OF TIME-KEEPING.

B. MICROPROCESSOR CONFIGURATION

THE PROCESSOR IS A ROCKWELL OR MOS TECHNOLOGY 6505 DEVICE USED IN A SIMPLE TWO CHIP CONFIGURATION ALONG WITH A 6530 MASKED ROM, RAM, TIMER, AND INPUT/OUTPUT DEVICE. ALL COMMUNICTION WITH THE CHARGER HARDWARE IS CARRIED OUT THROUGH THE 16 BIT I/O PORT OF THE 6530 AND THE INTERRUPT LINE OF THE PROCESSOR. AT NO POINT ARE THE DATA, ADDRESS, OR CONTROL SIGNALS USED IN THE CHARGER, THUS ALLOWING EASY RE-CONFIGURATION AS A SINGLE CHIP COMPUTER SYSTEM IN THE FUTURE.

C. INPUT SIGNAL DESCRIPTIONS

FOUR SIGNALS ARE SUPPLIED TO THE PROCESSOR FROM THE CHARGER CIRCUITS.

1. INTERRUPT

IN ORDER TO USE THE POWER LINE FREQUENCY TO PROVIDE AN ACCURATE TIME BASE TO RECORD THE DURATION OF A BATTERY DISCHARGE TEST, THE RECTIFIED POWER IS DIVIDED FIRST BY A CONSTANT (OPTIONS) AND THEN APPLIED TO AN INTERRUPT REQUEST FLIP-FLOP. THE INTERRUPT SERVICE ROUTINE WILL CLEAR THIS FLIP-FLOP AT THE END OF EACH EXECUTION. IT IS REQUIRED DUE TO THE LEVEL SENSITIVE NATURE OF THE IRQ LINE.

2. COMPARATOR RESULTS ---- PERIPHERAL DATA REGISTER B, BIT 7

ALL ANALOG INPUTS ARE READ BY THE PROCESSOR INTO BIT 7 OF PORT B. SINCE THIS IS THE SIGN BIT, AND THE NEGATIVE FLAG IN THE PROCESSOR STATUS WORD IS SET OR CLEARED AUTOMATICALLY ON EACH READ OPERATION BRANCHES MAY BE MADE ACCORDING TO THE VALUE OF THIS BIT WITHOUT FURTHER INSTRUCTIONS. ALL ANALOG MEASUREMENTS ARE MADE USING THIS INPUT, BY SENDING A VALUE TO THE DIGITAL TO ANALOG CONVERTER, PRODUCING A KNOWN VOLTAGE, ADDRESSING THE ANALOG MULTIPLEXERS TO CONNECT THE DESIRED SIGNAL, AND READING THE RESULTING DEFFIERNCE FROM THE COMPARATOR. ABSOLUTE VOLTAGE READINGS ARE MADE BY SUCCESSIVE APPROXIMATION IN SOFTWARE USING THE SAME INPUT.

3. DISCHARGE BATTERY < 3.0 V. ---- PERIPHERAL DATA REGISTER B, BIT 6

THIS INPUT WILL BE HIGH WHEN THE BATTERY VOLTAGE AT THE OPTIONAL DISCHARGE SOCKET IS BELOW 3.0 V OR MISSING.

4. DISCHARGE BATTERY > 6.0 V. ---- PERIPHERAL DATA REGISTER B, BIT 5

THIS INPUT WILL BE HIGH WHEN THE BATTERY VOLTAGE AT THE OPTIONAL DISCHARGE SOCKET IS ABOVE 6.0 V. OR NOT YET DISCHARGED.

D. OUTPUT SIGNAL DESCRIPTIONS

ALL EIGHT BITS OF PERIPHERAL DATA REGISTER A AND THE LOW ORDER FIVE BITS OF PERIPHERAL DATA REGISTER B ARE PROGRAMMED AS OUTPUTS.

TYPICALLY A VALUE OR BIT PATTERN IS WRITTEN TO PORT A AND ONE OR MORE OF THE PORT B BITS IS USED TO STROBE THAT VALUE OR PATTERN INTO ONE OR MORE OF THE DEVICES CONNECTED TO PORT A. THE DIGITAL TO ANALOG CONVERTER IS ALWAYS ACTIVE AND PRODUCES A VOLTAGE FROM 0 TO 10 VOLTS FOR VALUES OF $00 TO $FF.

1. DIGITAL TO ANALOG CONVERTER

PORT A BIT 0	LSB
PORT A BIT 1	:
PORT A BIT 2	:
PORT A BIT 3	:
PORT A BIT 4	:
PORT A BIT 5	:
PORT A BIT 6	:
PORT A BIT 7	MSB

2. EIGHT BIT TEMPORARY LATCH

PORT A BIT 0	LSB
PORT A BIT 1	:
PORT A BIT 2	:
PORT A BIT 3	:
PORT A BIT 4	:
PORT A BIT 5	:
PORT A BIT 6	:
PORT A BIT 7	MSB
PORT B BIT	CLOCK

3. EIGHT BIT ADDRESSABLE LATCH FOR CURRENT SWITCH CONTROL

LATCH BIT 0	ADDRESS LSB (BATTERY NUMBER)
LATCH BIT 1	:
LATCH BIT 2	ADDRESS MSB
PORT B BIT 1	CLOCK
LATCH BIT 6	DATA (ONE FOR ON -- ZERO FOR OFF)

4. EIGHT BIT ADDRESSABLE LATCH FOR LED INDICATOR CONTROL

LATCH BIT 0	ADDRESS LSB (BATTERY NUMBER)
LATCH BIT 1	:
LATCH BIT 2	ADDRESS MSB
PORT B BIT 2	CLOCK
LATCH BIT 7	DATA (ONE FOR ON -- ZERO FOR OFF)

5. ANALOG MULTIPLEXER CONTROLLING BATTERY SELECTION AND RT-2

LATCH BIT 0	ADDRESS LSB (BATTERY NUMBER OR RT-2)
LATCH BIT 1	:
LATCH BIT 2	ADDRESS MSB

6. ANALOG MULTIPLEXER CONTROLLING RESISTOR SELECTION OR RT-1

LATCH BIT 3	ADDRESS LSB
LATCH BIT 4	:
LATCH BIT 5	ADDRESS MSB

7. OPTIONAL DISPLAY INDICATOR, 2 DIGITS 0-F

LATCH BIT 0	LSB RIGHT DIGIT
LATCH BIT 1	:
LATCH BIT 2	:
LATCH BIT 3	MSB RIGHT DIGIT
LATCH BIT 4	LSB LEFT DIGIT
LATCH BIT 5	:
LATCH BIT 6	:
LATCH BIT 7	MSB LEFT DIGIT
PORT B BIT 3	CLOCK

8. INTERRUPT SERVICE REQUEST FLIP-FLOP

PORT B BIT 4	DRIVEN LOW TO SET THE FLIP-FLOP (CLEARING THE REQUEST)

D. ADDRESSING CONSIDERATIONS

1. READ ONLY MEMORRY

ROM IS ADDRESSED FROM 0C00 HEX TO 0FFF HEX. SINCE THE ADDRESS BITS ABOVE BIT 11 ARE NOT CONNECTED THE INTERRUPT AND RESET VECTORS AT THE TOP OF MEMORY FUNCTION TO SELECT THE TOP SIX BYTES IN THE LIMITED RANGE OF THE SYSTEM ROM.

2. RANDOM ACCESS MEMORY

RAM IS ADDRESSED FROM 0000 HEX THROUGH 003F HEX FOR DATA OPERATIONS AND FROM 01FF HEX DOWNWARD TO 0100 HEX FOR STACK OPERATIONS. SINCE ADDRESS BITS 6 THROUGH 8ARE NOT INCLUDED IN THE RAM DECODE, IT RESPONDS TO ALL ADDRESSES FROM 0000 HEX TO 01FF HEX WHICH ARE NOT EXPLICITY DECODED AS I/O. THEREFORE STACK ACCESSES ARE MADE FROM 01FF HEX DOWNWARD AND DATA ACCESSES ARE MADE FROM 0000 HEX UPWARD, SHARING THE SAME 64 BYTES. (NON-OVERLAPPING)

3. INPUT-OUTPUT

SHARING THE RAM ADDRESS SPACE IN ZERO-PAGE IS 16 BYTES OF SPACE ASSIGNED TO I/O AS FOLLOWS:

0040	READ PER. DATA REG A	WRITE PER. DATA REG A
0041	READ DATA DIRECTION A	WRITE DATA DIRECTION A
0042	READ PER. DATA REG A	WRITE PER. DATA REG B
0043	READ DATA DIRECTION B	WRITE DATA DIRECTION B
0045	READ TIMER FLAG	
0047		WRITE TIMER DATA, DISABLE INT.

OTHER I/O ADDRESS EXIST BUT ARE NOT USED.

2. SOFTWARE DESCRIPTION

SOFTWARE OPERATES IN THREE PRIMARY MODES, POWER APPLIED RESET, MAIN LOOP, AND INTERRUPT SERVICE.

A. POWER APPLIED RESET

POWER APPLIED RESET PASSES CONTROL INDIRECTLY THROUGH THE RESET VECTOR TO LABEL 'RESET',

RESET:
STACK POINTER IS PRESET TO TOP OF RAM
I/O INITIALIZATION IS ACCOMPLISHED BY COPYING T'TABL1'
INTO THE I/O COMPONENT USING AN INDEXED LOOP.

RES3:
ALL BATTERY CURRENT SWITCHES AND LEDS ARE TURNED OFF BY
CALLING SUBROUTINES 'SWIOFF' AND 'LEDOFF' IN AN INDEXED LOOP
THEN THE TEST BATTERY CURRENT DRAIN IS DISABLED BY A CALL TO 'TSTOFF'
CONTROL IS UNCONDITIONALLY PASSED TO 'SYSTST' WHICH WILL RETURN
CONTROL HERE ONLY IF HARDWARE TESTS ARE SUCESSFUL.

RESET1:
ON SUCCESSFUL COMPLETION OF HARDWARE TESTS, THE PROCESSOR REGISTERS
ARE AGAIN INITIALIZED,THE OPTIONAL DISPLAY DATA IS SET TO '00',
AND ALL VARIABLES ARE INITIALIZED BY COPYING 'TABL2' INTO RAM
USING AN INDEXED LOOP.

B. MAIN LOOP

THIS LOOP WILL BE REPEATED FOREVER, AND ON EACH PASS, A DIFFERENT BATTERY IS EXAMINED. TWO MAJOR CALLS TO EXTERNAL ROUTINES ARE MADE.

LOOP:

THE SUBROUTINE 'TEST' IS CALLED TO SERVICE THE OPTIONAL BATTERY DISCHARGER AND DISPLAY. IN THE EVENT NO OPTION IS INSTALLED, IT WILL BE A USELESS CALL BUT WILL ALWAYS RETURN CONTROL.

INTERRUPTS ARE ALLOWED

THE AMBIENT TEMPERATURE IS TESTED. IF IT IS GREATER THAN 'TMAX' THEN "EA" (EXCESSIVE AMBIENT) IS SENT TO THE DISPLAY VARIABLE 'DISPNO' AND 'MASK00' IS WRITTEN TO THE VARIABLE 'MDUTY' THEREBY PREVENTING ANY CHARGING TO OCCUR.

THE AMBIENT TEMPERATURE IS AGAIN TESTED. IF IT IS LESS THAN 'TMIN' THEN "C0" (COLD) IS SENT TO THE DISPLAY VARIABLE 'DISPNO' AND 'MDUTY' IS ALSO SET TO 'MASK00'.

LOOP3:

IF THE AMBIENT TEMPERATURE IS FOUND WITHIN THE LIMITS 'TMIN' TO 'TMAX' THEN THE POWER TRANSFORMER TEMPERATURE RISE IS TESTED. AN ABSOLUTE VOLTAGE MEASUREMENT IS MADE BY CALLING THE SUBROUTINE 'ADCONV'.
THE RESULT IS COMPARED WITH 'TST60', 'TST70', ETC IDENTIFYING THE TRANSFORMER AS BEING BETWEEN 60 AND 70 DEGREES C, BETWEEN 70 AND 80 DEGREES C AND SO ON. ACCORDINGLY, ONE OF THE CONSTANTS 'MSK100', 'MASK50', ETC WILL BE WRITTEN INTO THE VARIABLE 'MDUTY' WHICH IS USED BY THE SUBROUTINE 'CHARGE' TO LIMIT THE DUTY CYCLE AT WHICH ALL BATTERIES MAY BE CHARGED.
FINALLY A CALL TO SUBROUTINE 'CHARGE' IS MADE TO SERVICE THE N'TH BATTERY.

ON RETURN, THE VARIABLE 'BATNUM' WHICH IDENTIFIES THE CURRENTLY ACTIVE BATTERY IS INCREMENTED, TESTED FOR OVERFLOW AND CONTROL IS PASSED BACK TO THE LABEL 'LOOP' RESTARTING THE SEQUENCE FOR THE NEXT BATTERY.

DISPLA: (SUBROUTINE)

TRANSFERS THE CONTENTS OF THE ACCUMULATOR TO THE OPTIONAL DISPLAY

CLKL: (SUBROUTINE)

TRANSFERS THE CONTENTS OF PER. DATA REG A TO THE TEMPORARY DATA LATCH

CLKS: (SUBROUTINE)

TRANSFERS THE TEMPORARY LATCH TO THE EIGHT BIT ADDRESSABLE LATCH CONTROLLING THE CURRENT SWITCHES FOR THE BATTERIES (0-5) AS FOLLOWS:

BITS 0,1,2 CONTAIN THE BATTERY ADDRESS
BIT 6 CONTAINS 1 FOR ON - 0 FOR OFF

CLKS: (SUBROUTINE)

TRANSFERS THE TEMPORARY LATCH TO THE EIGHT BIT ADDRESSABLE LATCH CONTROLLING THE LED INDICATORS FOR THE BATTERIES (0-5) AS FOLLOWS:

BITS 0,1,2 CONTAIN THE BATTERY ADDRESS
BIT 7 CONTAINS 1 FOR ON - 0 FOR OFF

MISNG: (SUBROUTINE)

DETERMINES IF THE BATTERY ADDRESSED BY THE X REG IS STILL IN THE SOCKET. THE OPEN CIRCUIT VOLTAGE AT THE THERMISTOR TERMINAL IS COMPARED WITH 'V3X0' (3.0V). TWO IDENTICAL RESULTS ARE REQUIRED SEPARATED BY A 50 MILLISECOND DELAY INORDER TO RETURN A "MISSING" INDICATION. RESULTS RETURNED IN THE SIGN BIT OF THE PROCESSOR STATUS BYTE, NEGATIVE IF BATTERY IS MISSING.

ADCONV: (SUBROUTINE)

THE REGISTER X IS TAKEN AS ADDRESSES FOR THE ANALOG MULTIPLEXERS AND AN ABSOLUTE VOLTAGE MEASUREMENT IS MADE ON THE REQUESTED VOLTAGE BY SOFTWARE SUCESSIVE APPROXIMATION. RESULTS ARE RETURNED IN THE ACCUMULATOR.

COMPAR: (SUBROUTINE)
CMPDAC: (SUBROUTINE)

THE REGISTER X (FOR CMPDAC) OR THE ACCUMULATOR (FOR COMPAR) IS TAKEN AS ADDRESSES FOR THE ANALOG MULTIPLEXERS, AND THE REGISTER Y AS THE KNOWN VALUE. THE VOLTAGE ADDRESSED BY THE MULTIPLEXERS IS COMPARED TO THE KNOWN VALUE AND RESULTS RETURNED AS FOLLOWS:

SIGN = NEG IF Y>UNKNOWN
       POS IF Y<UNKNOWN
EQUALITY IS NOT VALID, AS SOME DECISION MUST BE MADE.

DLY: (SUBROUTINE)

A SHORT DELAY LOOP USED FOR ANALOG SETTLING TIME WAITS.

SWIOFF: (SUBROUTINE)

TURNS OFF THE CURRENT TO THE BATTERY ADDRESSED BY THE 3 LEAST SIGNIFICANT BITS OF THE X REG.

SWION: (SUBROUTINE)

TURNS ON THE CURRENT TO THE BATTERY ADDRESSED BY THE 3 LEAST SIGNIFICANT BITS OF THE X REG.

LEDOFF: (SUBROUTINE)

TURNS OFF THE INDICATOR ADDRESSED BY THE 3 LEAST SIGNIFICANT BITS OF THE X REG.

LEDON: (SUBROUTINE)

TURNS ON THE INDICATOR ADDRESSED BY THE 3 LEAST SIGNIFICANT BITS OF THE X REG.

TESTON: (SUBROUTINE)

TURNS ON THE CURRENT DRAIN FOR THE OPTIONAL BATTERY TEST CIRCUIT

TESTOFF: (SUBROUTINE)
TURNS OFF THE CURRENT DRAIN FOR THE OPTIONAL BATTERY TEST CIRCIUT.

TEST: (SUBROUTINE)
TESTS THE LEAST SIGNIFICANT THREE BITS OF 'TESTAT' TO DETERMINE THE CURRENT STATUS OF THE BATTERY UNDER TEST, AND TRANSFERS CONTROL TO 'FREE','DUMP',OR 'DEAD' ACCORDINGLY BY EXECUTING A COMPUTED INDIRECT JUMP TO THE N'TH ENTRY IN 'TTABL'
NOTE: THE ONLY MODIFICATION OF THE DISPLAY IS IN THESE THREE SUBROUTINES, THEREFORE THE PROIORITY OF THE DISPLAY IS DETERMINED

```
TO BE: FIRST    DISCHARGE FUNCTIONS
       SECOND   OVER-UNDER TEMP
```

FREE: (CASE 0 OF 'TEST')

IT IS ASSUMED THAT NO BATTERY IS INSERTED IN THE DISCHARGE CONNECTOR.
THE CONTENTS OF 'DISPNO' ARE SENT TO THE DISPLAY.
BIT 5 OF PORT B IS TESTED TO DETERMINE IF A BATTERY OF GREATER THAN 6.0 VOLTS HAS BEEN INSERTED, AND IF NOT, CONTROL IS TRANSFERRED TO 'DEL', WHICH RETURNS CONTROL TO THE CALLING ROUTINE.
OTHERWISE, 'TESTAT' IS CHANGED TO 1, POINTING TO 'DUMP' AND THE VALUE OF 'MINS' IS INITIALIZED TO '00' TO BEGIN TIMING THE DISCHARGE CYCLE.
CONTROL PASSES THROUGH 'DEL' TO THE CALLING ROUTINE.

DUMP: (CASE 1 OF 'TEST')
IT IS ASSUMED THAT A BATTERY IS BEING DISCHARGED.
TRANSFERS 'DC' (DISCHARGE) TO THE DISPLAY, RATHER THAN THE VALUE SAVED IN 'DISPNO', AND CALLS 'TESTON' TO ENABLE THE CONSTANT CURRENT DISCHARGE OF THE TEST BATTERY. TESTS BIT 5 OF PORT B TO DETERMINE IF THE BATTERY HAS FINISHED DISCHARGING AND TRANSFERS CONTROL TO 'DEL' IF NOT. OTHERWISE, TURNS OFF THE DISCHARGE CURRENT SINK AND COPIES THE ACCUMULATED VALUE FROM 'MINS' FOR DISPLAY.
'TESTAT' IS CHANGED TO 2, POINTING TO 'DEAD' AND CONTROL PASSES THROUGH 'DEL' BACK TO THE CALLING ROUTINE.

DEAD: (CASE 2,3 OF 'TEST')

IT IS ASSUMED THAT THE BATTERY HAS BEEN DISCHARGED BELOW 6.0 VOLTS
'BATIME', THE ACCUMULATED DISCHARGE TIME, IS TRANSFERRED TO THE DISPLAY.
BIT 7 OF PORT B IS TESTED TO SEE IF THE BATTERY IS BELOW 3.0 VOLTS, INDICATING REMOVAL. IF THE BATTERY HAS NOT BEEN REMOVED, THEN CONTROL PASSES THROUGH 'DEL' BACK TO THE CALLING ROUTINE.
IF THE BATTERY HAS BEEN REMOVED, THEN 'TESTAT' IS SET TO '0', POINTING TO CASE 'FREE' AGAIN, AND CONTROL IS PASSED THROUGH 'DEL' BACK TO THE CALLING ROUTINE.

CHARGE: (SUBROUTINE)

THIS IS THE MAIN BATTERY SERVICE ROUTINE. IT IS ENTERED WITH 'BATNUM' CONTAINING A POINTER TO THE BATTERY TO BE SERVICED, AND 'STAT' INDEXED BY BATNUM INDICATES THE CURRENT STATUS OF THAT BATTERY.

DEPENDING ON THE CONTENTS OF 'STAT'('BATNUM'), A COMPUTED INDIRECT JUMP IS MADE TO ONE OF 5 POSSIBLE CASES, 'NOBATT','RDY', 'UNSAFE','CHRG',OR 'DONE'.

NOBATT: (CASE 0 OF 'CHARGE')

IT IS ASSUMED THAT NO BATTERY IS INSTALLED IN THE N'TH CHARGING SOCKET. TWO CONSECUTIVE TESTS ARE MADE, SEPARATED BY 50 MS. TO DETERMINE IF THE SOCKET VOLTAGE IS > 7.2 V. IF EITHER FAILS, NO BATTERY PRESENT IS ASSUMED, AND CONTROL IS RETURNED TO TE CALLING ROUTINE WITHOUT CHANGE. IF BOTH PASS, THEN 'STAT' IS SET TO 1, POINTING TO 'RDY' FOR THIS BATTERY AND CONTROL IS RETURNED.

RDY: (CASE 1 OF 'CHARGE')

IT IS ASSUMED THAT A BATTERY GREATER THAN 7.2 VOLTS HAS BEEN FOUND IN THE SOCKET. A CALL IS MADE TO 'SETDTY' TO DETERMINE THE MAXIMUM CHARGE RATE FOR THIS BATTERY. IF 'SETDTY' RETURNS A NON-SAFE RESULT, (ZERO FLAG SET) THEN STAT FOR THIS BATTERY IS SET TO 2, POINTING TO 'UNSAFE', AND CONTROL IS RETURNED. IF 'SETDTY' RETURNS A SAFE CONDITION (ZERO FLAG CLR) THEN THE OPEN CIRCUIT BATTERY VOLTAGE IS MEASURED BY CALLING 'ADCONV' AND MULTIPLIED BY 0.612. THE RESULT IS COMPARED WITH THE VOLTAGE FROM THE BATTERY WITH THE AMBIENT THERMISTOR CONNECTED, AND IF THE RESULT IS TOO HIGH, 'STAT' IS SET TO 2 (UNSAFE, THE BATTERY IS ALREADY TO HOT) AND CONTROL IS RETURNED. IF THE VOLTAGE IS LOWER, THEN 'STAT' IS SET TO 3 (CHRG) AND CONTROL RETURNED. IN THIS EVENT THE LED FOR THIS BATTERY IS TURNED OFF UNCONDITIONALLY, SINCE IT MAY HAVE HAS BEEN ON OR BLINKING.

UNSAFE: (CASE 2 OF 'CHARGE')

IT IS ASSUMED THAT A BATTERY IS IN THE SOCKET, BUT IT HAS BEEN MARKED AS UNSAFE TO CHARGE, DUE TO TEMPERATURE OF THE CELLS. FIRST A TEST IS MADE TO DETERMINE IF THE BATTERY HAS BEEN REMOVED BY CALLING 'MISNG'. IF IT IS FOUND TO HAVE BEEN REMOVED, THEN 'STAT' IS SET TO 0 ('NOBATT') AND THE INDICATOR IS UNCONDITIONALLY TURNED OFF, CONTROL IS RETURNED TO THE CALLING ROUTINE.
IF IT IS STILL THERE, A CALL IS MADE TO THE CASE 1 ROUTINE, WHICH ORIGINALLY DETERMINED THE STATUS OF THE BATTERY, FOR A RE-TEST. IF 'RDY' FINDS THE BATTERY ACCEPTABLE TO CHARGE, THE VALUE OF 'STAT' WILL HAVE BEEN CHANGED IN THAT ROUTINE TO 3. IF NOT IT WILL AGAIN BE RETURNED AS 2 'UNSAFE'. WHEN THE UNSAFE INDICATION IS RETURNED, THE VALUE OF 'BLINK' IS INCREMENTED ONCE FOR EACH EXECUTION, AND DEPENDING ON THE RESULTING STATE OF BIT 0 THE INDICATOR WILL BE TURNED ON OR OFF, CAUSING IT TO BLINK APPROXIMATELY THREE TIMES PER SECOND AS LONG AS THE BATTERY REMAINS IN THIS STATE.
CONTROL IS RETURNED TO THE CALLING ROUTINE.

CHRG: (CASE 3 OF 'CHARGE')

IT IS ASSUMED THAT THE BATTERY IS NOW BEING CHARGED. FIRST A CALL TO 'SWIOFF' STOPS THE CHARGING CURRENT DURING THESE TESTS. A 10 MS. DELAY IS EXECUTED TO ALLOW THE CELL VOLTAGE TO STABALIZE. THE ABSOLUTE BATTERY VOLTAGE IS MEASURED BY CALLING 'ADCONV'. IF THE VOLTAGE IS GREATER THAN 9.15 V. THEN 'STAT' IS MARKED 'DONE' BY SETTING IT TO 4, AND CONTROL IS RETURNED TO THE CALLING ROUTINE. OTHERWISE, THE CELL VOLTAGE TIMES 0.625 IS COMPARED TO THE BATTERY VOLTAGE WITH THE AMBIENT THERMISTOR CONNECTED BY CALLING 'COMPAR'. IF THE CELL TEMPERATURE IS HIGHER THAN 10 DEG. C. ABOVE AMBIENT, THEN 'STAT' IS LIKEWISE MARKED 'DONE' DUE TO TEMPERATURE SHUTOFF, AND CONTROL IS RETURNED TO THE CALLING ROUTINE. OTHERWISE, A CALL IS MADE TO 'MISNG' IN THE EVENT THE BATTERY HAS BEEN REMOVED, AND IF SO, IT IS IMMEDIATELY MARKED 0 AND CONTROL IS RETURNED.

IF THE BATTERY IS NOT MISSING, NOT OVERVOLTAGE, AND NOT OVERTEMPERATURE THEN CHARGING CONTINUES:

THE VALUE OF 'DUTY' SAVED FOR EACH BATTERY IS PRESET WITH ONES IN THE MOST SIGNIFICANT BITS, SUCH THAT ALL ONES INDICATES 100% CHARGE, AND LESS ONES INDICATES A LOWER PERCENTAGE CHARGE CUTY CYCLE. IT IS ROTATED RIGHT FOR EACH EXECUTION OF 'CHRG' AND IF THE LSB IS A ONE, CURRENT IS SUPPLIED TO THE BATTERY FOR THIS CYCLE. ALL ZEROES INDICATES THAT EITHER ALL ONES HAVE BEEN SHIFTED OUT TO THE RIGHT, OR THE REQUIRED DUTY CYCLE WAS 0%. IN EITHER CASE, A CALL IS MADE TO 'SETDTY' TO REFRESH THE VALUE. CONTROL IS RETURNED TO THE CALLING ROUTINE.

DONE: (CASE 4 OF 'CHARGE')

IT IS ASSUMED THAT THE BATTERY HAS BEEN CHARGED, AND IS WAITING TO BE REMOVED.

A CALL TO 'MISNG' DETERMINES IF THE BATTERY IS STILL THERE. IF IT IS THE LED IS TURNED ON (REPEATEDLY) AND CONTROL IS RETURNED. IF IT IS NOT STILL THERE, THE INDICATOR AND CHARGE CURRENT ARE TURNED OFF AND THE 'STAT' MARKED 'NOBATT' FOR A NEW CYCLE. CONTROL IS RETURNED TO THE CALLING ROUTINE.

SETDTY: (SUBROUTINE)

THE BATTERY TEMPERATURE IS PLACED IN ONE OF SEVERAL CATEGORIES BY COMPARING ONE HALF THE OPEN CIRCUIT VOLTAGE WITH THE VOLTAGE OBTAINED WITH VARIOUS FIXED RESISTORS CONNECTED IN PLACE OF THE AMBIENT THERMISTOR. A 'MASK' VALUE IS WRITTEN IN THE 'DUTY' LOCATION FOR A BATTERY WHICH INCLUDES THE EFFECTIVE CURRENT VALUE OF 'MDUTY' OR THE MASTER DUTY CYCLE WHICH IS DETERMINED FROM TRANSFORMER AND AMBIENT TEMPERATURES.

BATT TEMP	DUTY CYCLE
>=20 DEG	100 %
>=15 DEG	75 %
>=10 DEG	50 %
>= 5 DEG	25 %
< 5 DEG	00 %

DEL: (SUBROUTINE)

THIS SUBROUTINE DELAYS 40 MILLISECONDS BEFORE RETURNING CONTROL TO THE CALLER.

SYSTST: (MAINLINE SYSTEM TEST ROUTINE)

THIS ROUTINE IS NOT CALLED AS A SUBROUTINE, SINCE IT DESTROYS THE CONTENTS OF THE STACK AND IT'S RETURN ADDRESS.

USING THE POLYNOMIAL X↑8 + X↑5 + X↑3 + 1 , THE CYCLIC REDUNDENCY CHECK WORD IS CALCULATED FOR THE CONTENTS OF ALL READ ONLY MEMORY PRIOR TO THIS ADDRESS. IT IS COMPARED TO 'GOOD', WHICH HAS BEEN INDEPENDENTLY CALCULATED AND SUPPLIED TO THE PROGRAM AS AN EQUATE STATEMENT. ON FAILURE CONTROL IS PASSED TO 'FAILED', WHERE THE PROGRAM BECOMES TRAPPED, AND NO CHARGING OCCURS.

IF THE READ ONLY MEMORY HAS NO ERRORS, THEN THE RAM IS TESTED BY WRITING THE ADDRESS OF EACH CELL UPWARD THROUGH MEMORY, READING THEM BACKWARD AND TESTING EACH ONE, THEN INVERTING, WRITING BACK, AND TESTING EACH CELL. THIS INSURES THAT EACH LOCATION CAN BE UNIQUELY ADDRESSED AND THAT EACH BIT OF EACH CELL CAN BE WRITTEN AND READ. THIS IS NOT A FOOLPROOF TEST !!!!!

IF RAM AND ROM ARE BOTH ACCEPTED THEN CONTROL IS PASSES TO 'LOOP' WHICH IS THE MAIN BODY OF THE PROGRAM. OTHERWISE CONTROL IS PASSED TO 'FAILED' WHERE "FA" IS DISPLAYED AND NO CHARGING CAN OCCUR.

C. INTERRUPT SERVICE

IRQ: (THE INTERRUPT SERVICE ROUTINE)

THE INTERRUPT SERVICE FLIP-FLOP IS RESET (ACTIVE) BY A TRANSISTION OF THE BORROW OUTPUT OF THE COUNTER CONNECTED TO THE RECTIFIED POWER TRANSFORMER OUTPUT.
IT WILL REMAIN IN THAT STATE UNTIL SET BY A NEGATIVE PULSE FROM PORT B BIT 4, WHICH IS GENERATED WITHIN THE INTERRUPT SERVICE ROUTINE.
THE PURPOSE OF THE INTERRUPT SERVICE ROUTINE IS TO COUNT POWER LINE TRANSISTIONS AND ACCUMULATE A VALUE 'MINS', WHICH MAY BE USED TO INDICATE THE NUMBER OF MINUTES THAT WERE REQUIRED TO DISCHARGE THE TEST BATTERY, OR ALTERNATELY THE PERCENT OF FULL CHARGE CONTAINED IN THAT BATTERY. 720 INTERRUPTS ARE REQUIRED TO ADVANCE THE CONTENTS OF 'MINS' ONE COUNT. THE POWER LINE SIGNAL IS FULLWAVE RECTIFIED PROVIDING 120 PULSES PER SECOND AT 60 HZ., AND 100 PULSES PER SECOND AT 50 HZ.

OPTIONAL TRACE CUTTING ON THE CIRCUIT BOARD ALLOWS THE FOLLOWING:

DIVIDER MODULO = 10 POWER LINE FREQ = 60 HZ.

PROVIDES 12 INTERRUPTS PER SECOND OR 720 PER COUNT CAUSING THE OPTION DISPLAY TO READ 'MINUTES' OF DISCHARGE, 00-99

```
DIVIDER MODULO = 6      POWER LINE FREQ = 60 HZ.

    PROVIDES 20 INTERRUPTS PER SECOND OR 720 PER COUNT CAUSING THE
    OPTION DISPLAY TO READ 'PERCENT' OF ONE HOUR DISCHARGE, 00-99

DIVIDER MODULO = 5      POWER LINE FREQ = 50

    PROVIDES 20 INTERRUPTS PER SECOND OR 720 PER COUNT CAUSING THE
    OPTION DISPLAY TO READ 'PERCENT' OF ONE HOUR DISCHARGE, 00-99

    ** NO PROVISION IS MADE TO INDICATE MINUTES AT 50 HZ.

EOF
```

SOFTWARE LISTING

```
LINE # LOC      CODE      LINE
       0000               ;
       0000               ;*****************************************************
       0000               ;*                                                   *
       0000               ;* MPR 1 HR MULTI CHARGER CONTROLLER V2.7 09 MAY 79  *
       0000               ;*                                                   *
       0000               ;*****************************************************
       0000               ;
       0000               ;
       0000               ;HARDWARE DEPENDANT ADDRESSES
       0000               ;----------------------------
       0000               ;
       0000               RAMBAS = $0000          ;BEGIN RAM
       0000               RAMSIZ = 64             ;NR BYTES RAM
       0000               STACK  = RAMBAS+RAMSIZ-1
       0000               ROMBAS = $C00           ;PERMANENT
       0000               ROMSIZ = 1024
       0000               NMI    = IRQ
       0000               IOBASE = $40
       0000               PRA    = IOBASE+0
       0000               PRB    = IOBASE+2
       0000               SETIME = IOBASE+7       ;1024 X TIMER NO INTRPT
       0000               RDTIME = IOBASE+5
       0000               ;
       0000               ;CONSTANTS
       0000               ;----------
       0000               ;
       0000               TIME    = 10            ; DELAY IN LOOP
       0000               TMAX    = $23           ;HIGHEST AMBIENT TEMP
       0000               TMIN    = $64           ;LOWEST AMBIENT TEMP
       0000               OFF     = %10111111     ;SWITCH OFF MASK
       0000               ON      = %01000000     ;SWITCH ON MASK
       0000               LOFF    = %01111111     ;LED OFF MASK
       0000               LON     = %10000000     ;LED ON MASK
       0000               ATEMP   = %00111110     ;RT1 AND R43 TO MUX
       0000               BTEMP   = %00111000     ;RT1 AND BATT
       0000               BTEM20 = %00011000      ;R47 AND BATT TO MUX
       0000               BTEM15 = %00100000      ;R48 AND BATT TO MUX
       0000               BTEM10 = %00101000      ;R49 AND BATT TO MUX
       0000               BTEM05 = %00110000      ;R50 AND BATT TO MUX
       0000               XTEMP   = %00001111     ;RT2 AND R45 0 MUX
       0000               TST80   = 85            ;80 DEG C VALUE
       0000               TST70   = 74            ;70
       0000               TST60   = 62            ;60
       0000               MSK100 = %11111111      ;100 % DUTY CYCLE
       0000               MASK75 = %11111100
       0000               MASK50 = %11110000      ;50  %
       0000               MASK25 = %11000000      ;25  %
       0000               MASK00 = %00000000      ;00  %
       0000               V7X2    = 184           ;(7.2/10)*256
       0000               V3X0    = 77            ;(3.0/10)*256
       0000               V9X1    = 232           ;(9.1/10)*256
       0000               CLRMSK = %11101111      ;BIT 4 RESETS FF
       0000               IRQMSK = %00010000      ;BIT 4 ALLOWS FF
       0000               ;
       0000               ;ZERO PAGE ASSIGNMENTS
```

```
LINE # LOC      CODE          LINE

0057   0000                 ;---------------------
0058   0000                 ;
0059   0000                          *=0
0060   0000                 STAT     *=*+6          ;CURRENT STATUS WORD
0061   0006                 DUTY     *=*+6          ;CURRENT DUTY CYCLE
0062   000C                 BLINK    *=*+6
0063   0012                 MDUTY    *=*+1          ;TRANSFORMER TEMP
0064   0013                 TIC      *=*+1          ;FRAC SECOND
0065   0014                 SECS     *=*+1          ;SECOND
0066   0015                 MIN      *=*+1          ;MINUTES (DECIMAL) 0-99
0067   0016                 BATNUM   *=*+1          ;INDEX TO AATIVE BATT
0068   0017                 TESTAT   *=*+1          ;TEST BATTERY STATUS
0069   0018                 DISPNO   *=*+1          ;NUMBER TO DISPLAY
0070   0019                 MASK     *=*+1          ;VARIABLE MASK FOR A-D CONV
0071   001A                 JMPLOC   *=*+2          ;JMP IND HERE TO CASE(N)
0072   001C                 REG      *=*+1          ;REGISTER FOR SETDTY
0073   001D                 BATIME   *=*+1          ;TIME TO DISPLAY
0074   001E                 ;
0075   001E                 ;BEGINNING OF ROM
0076   001E                 ;-----------------
0077   001E                 ;
0078   001E                          *=ROMBAS
0079   0C00                 ;
0080   0C00   4C 22 0C               JMP RESET
0081   0C03                 ;
0082   0C03                 ;INITIALIZATION TABLE
0083   0C03                 ;--------------------
0084   0C03                 ;
0085   0C03                 ;I/O SETUP IMAGE
0086   0C03                 ;
0087   0C03                 TABL1
0088   0C03   00                       .BYTE %00000000 ;PRA
0089   0C04   FF                       .BYTE %11111111 ;DDRA
0090   0C05   16                       .BYTE %00010110 ;PRB
0091   0C06   1F                       .BYTE %00011111 ;DDRB
0092   0C07   01                       .BYTE %00000001 ;TIMER 1X NO INT
0093   0C08                 ;
0094   0C08                 ;ZERO PAGE IMAGE
0095   0C08                 ;---------------
0096   0C08                 ;
0097   0C08                 TABL2
0098   0C08   00                       .BYTE 0,0,0,0,0,0 ;INITIAL STATUS
0098   0C09   00
0098   0C0A   00
0098   0C0B   00
0098   0C0C   00
0098   0C0D   00
0099   0C0E   00                       .BYTE 0,0,0,0,0,0 ;INITIAL DUTY CYCLE
0099   0C0F   00
0099   0C10   00
0099   0C11   00
0099   0C12   00
0099   0C13   00
0100   0C14   00                       .BYTE 0,0,0,0,0,0 ;INITIAL BLINK BIT
0100   0C15   00
```

```
LINE # LOC     CODE        LINE

0100   0C16  00
0100   0C17  00
0100   0C18  00
0100   0C19  00
0101   0C1A  00                   .BYTE 0          ;INITIAL MASTER DUTY CYCLE
0102   0C1B  0C                   .BYTE 12,60,0    ;INITIAL TIME
0102   0C1C  3C
0102   0C1D  00
0103   0C1E  00                   .BYTE 0          ;INITIAL BATT NO.
0104   0C1F  00                   .BYTE 0          ;INITIAL TEST BATT STAT
0105   0C20  00                   .BYTE 0          ;INITIAL DISP NUM
0106   0C21  C0                   .BYTE %11000000 ;INITIAL MASK
0107   0C22               ;
0108   0C22               ;COLD START VECTORS HERE TO INITIALIZE
0109   0C22               ;
0110   0C22               RESET
0111   0C22               ;
0112   0C22               ;SET UP STACK POINTER
0113   0C22               ;
0114   0C22  A2 3F                LDX #RAMSIZ-1
0115   0C24  9A                   TXS
0116   0C25               ;
0117   0C25               ;THEN THE I/O MUST BE SETUP
0118   0C25               ;
0119   0C25  A2 03                LDX #3           ;NO. OF LOCS
0120   0C27               RES1
0121   0C27  BD 03 0C             LDA TABL1,X      ;GET BYTE FROM TABLE
0122   0C2A  95 40                STA IOBASE,X     ;WRITE IT TO PIA
0123   0C2C  CA                   DEX              ;NEXT
0124   0C2D  10 F8                BPL RES1         ;LOOP UNTIL DONE
0125   0C2F               ;
0126   0C2F               ;THEN BATTERIES MUST BE MADE SAFE
0127   0C2F               ;AND INDICATORS TURNED OFF
0128   0C2F               ;
0129   0C2F  A2 05                LDX #5           ;SIX PORTS ON 74LS259
0130   0C31               RES3
0131   0C31  20 35 0D             JSR SWIOFF       ;TURN OFF SWITCH
0132   0C34  20 46 0D             JSR LEDOFF       ;TURN OFF LED
0133   0C37  CA                   DEX              ;NEXT
0134   0C38  10 F7                BPL RES3         ;LOOP UNTIL DONE
0135   0C3A  20 5C 0D             JSR TSTOFF       ;THE TEST BATT TOO
0136   0C3D  4C 40 0F             JMP SYSTST       ;CHECK THE HARDWARE VALIDITY
0137   0C40               ;
0138   0C40               ;RETURN HERE IF HARDWARE IS OK
0139   0C40               ;
0140   0C40               RESET1
0141   0C40  78                   SEI              ;DISABLE INTS
0142   0C41  D8                   CLD              ;CLEAR DECIMAL MODE
0143   0C42  A2 3F                LDX #STACK
0144   0C44  9A                   TXS              ;INITIALIZE STACK POINTER ***
0145   0C45  A9 00                LDA #0           ;DEFAULT DISPLAY VALUE
0146   0C47  85 18                STA DISPNO
0147   0C49               ;
0148   0C49  A2 19                LDX #MASK        ;MOVE ZERO PG VAR
0149   0C4B               RES2
```

```
LINE # LOC     CODE        LINE

0150  0C4B  BD 08 0C          LDA TABL2,X     ;GET VALUE
0151  0C4E  95 00             STA RAMBAS,X    ;PUT VALUE
0152  0C50  CA                DEX             ;COUNT
0153  0C51  10 F8             BPL RES2
0154  0C53             ;
0155  0C53             ;
0156  0C53             ;******** MAIN LOOP ********
0157  0C53             ;
0158  0C53             LOOP
0159  0C53  20 61 0D          JSR TEST        ;SERVICE THE TEST BATT AND DIS
0160  0C56  58                CLI             ;ALLOW INTERRUPTS NOW
0161  0C57  A0 23             LDY #TMAX       ;AMB TEMP LIMIT (HOT)
0162  0C59  A2 3E             LDX #ATEMP      ;ADDRESS THE AMB THERM
0163  0C5B  20 1B 0D          JSR CMPDAC      ;MAKE TEST
0164  0C5E  30 09             BMI LOOP1       ;BRANCH IF OK
0165  0C60  A9 EA             LDA ##EA        ;"EXCESS AMBIENT"
0166  0C62  85 18             STA DISPNO      ;SHOW IT
0167  0C64             LOOP4
0168  0C64  A9 00             LDA #MASK00     ;KILL ALL BATTS
0169  0C66  4C 9A 0C          JMP LOOP12      ;SKIP XFMR TST
0170  0C69             LOOP1
0171  0C69  A0 64             LDY #TMIN       ;AMB TEMP LIMIT (COLD)
0172  0C6B  20 1B 0D          JSR CMPDAC      ;MAKE TEST
0173  0C6E  10 07             BPL LOOP3       ;BRANCH IF OK
0174  0C70  A9 C0             LDA ##C0        ;"COLD"
0175  0C72  85 18             STA DISPNO
0176  0C74  4C 64 0C          JMP LOOP4
0177  0C77             ;
0178  0C77             ;DETERMINE THE XFMR TEMP AND
0179  0C77             ;LIMIT DUTY CYCLE ACCORDINGLY
0180  0C77             ;
0181  0C77             LOOP3
0182  0C77  A9 00             LDA #0
0183  0C79  85 18             STA DISPNO      ;SHOW SAFE IN DISP
0184  0C7B  A2 0F             LDX #XTEMP      ;XFMR TEMP MEAS
0185  0C7D  20 F3 0C          JSR ADCONV      ;READ XFMR TEMP
0186  0C80  C9 3E             CMP #TST60
0187  0C82  B0 04             BCS LOOP6       ;BR IF T>60
0188  0C84  A9 FF             LDA #MSK100
0189  0C86  D0 12             BNE LOOP12
0190  0C88             LOOP6
0191  0C88  C9 4A             CMP #TST70
0192  0C8A  B0 04             BCS LOOP7       ;BR IF T>70
0193  0C8C  A9 F0             LDA #MASK50
0194  0C8E  D0 0A             BNE LOOP12
0195  0C90             LOOP7
0196  0C90  C9 55             CMP #TST80
0197  0C92  B0 04             BCS LOOP8       ;BR IF T>80
0198  0C94  A9 C0             LDA #MASK25
0199  0C96  D0 02             BNE LOOP12
0200  0C98             LOOP8
0201  0C98  A9 00             LDA #MASK00
0202  0C9A             LOOP12
0203  0C9A  85 12             STA MDUTY       ;STORE LIMIT MASK
0204  0C9C             ;
```

```
LINE # LOC     CODE        LINE

       0C9C                ;CHARGE THE BATTERY ADDRESSED BY THE
       0C9C                ;CONTENTS OF BATNUM
       0C9C                ;
       0C9C   20 C0 0D            JSR CHARGE
       0C9F                ;
       0C9F                ;INDEX TO THE NEXT BATT AND
       0C9F                ;TEST FOR FINISHED
       0C9F                ;
       0C9F   E6 16               INC BATNUM       ;NEXT BATT
       0CA1   A9 05               LDA #5           ;TEST VAL
       0CA3   C5 16               CMP BATNUM       ;DONE ?
       0CA5   B0 04               BCS LOOP5
       0CA7   A9 00               LDA #0           ;RESTART AT FIRST BATT
       0CA9   85 16               STA BATNUM
       0CAB                LOOP5
       0CAB   4C 53 0C            JMP LOOP         ;AND CONTINUE
       0CAE                ;
       0CAE                ;******** SUBROUTINE DISPLA  ********
       0CAE                ;
       0CAE                ;STORE THE A REG INTO THE OPTION DISPLAY
       0CAE                ;A,P,LATCH MODIFIED
       0CAE                ;
       0CAE                DISPLA
       0CAE   85 40               STA PRA          ;PUT IN PORT
       0CB0   20 BF 0C            JSR CLKL         ;SHIFT TO LATCH
       0CB3   A9 08               LDA #%00001000 ;TO SET BIT 3
       0CB5   05 42               ORA PRB          ;COMBINE WITH PORT
       0CB7   85 42               STA PRB
       0CB9   49 08               EOR #%00001000 ;CLEAR SAME BIT
       0CBB   85 42               STA PRB          ;AND RESTORE PORT
       0CBD   60                  RTS
       0CBE                ;
       0CBE   60                  RTS
       0CBF                ;
       0CBF                ;
       0CBF                ;******** SUBTOUTINE CLKL ********
       0CBF                ;
       0CBF                ;--FOR ALL FUNCTIONS EXCEPT D-A CONV--
       0CBF                ;CLOCK THE CONTENTS OF PRA INTO THE LATCH
       0CBF                ;P MODIFIED
       0CBF                ;
       0CBF                CLKL
       0CBF   E6 42               INC PRB          ;LSB == 1
       0CC1   C6 42               DEC PRB          ;LSB == 0
       0CC3   60                  RTS
       0CC4                ;
       0CC4                ;
       0CC4                ;******** SUBROUTINE CLKS ********
       0CC4                ;
       0CC4                ;--FOR THE SWITCHES--
       0CC4                ;CLOCK THE DATA ON LATCH BIT 6 TO THE
       0CC4                ;OUTPUT PIN ADDRESSED BY THE 3 LSB OF
       0CC4                ;THE LATCH
       0CC4                ;A,P MODIFIED
       0CC4                ;
```

```
LOC     CODE        LINE

0CC4                CLKS
0CC4   A9 FD               LDA #%11111101 ;MASK TO CLR BIT 1
0CC6   25 42               AND PRB        ;PRESERVE OLD
0CC8   85 42               STA PRB        ;STORE NEW
0CCA   09 02               ORA #%00000010 ;RESTORE BIT
0CCC   85 42               STA PRB        ;AND REPLACE IT
0CCE   60                  RTS
0CCF                ;
0CCF                ;
0CCF                ;******** SUBROUTINE CLKI ********
0CCF                ;
0CCF                ;--FOR THE LEDS--
0CCF                ;CLOCK THE DATA ON LATCH BIT 7 TO THE
0CCF                ;OUTPUT PIN ADDRESSED BY THE 3 LSB OF
0CCF                ;THE LATCH
0CCF                ;A,P MODIFIED
0CCF                ;
0CCF                CLKI
0CCF   A9 FB               LDA #%11111011 ;MASK TO CLR BIT 2
0CD1   25 42               AND PRB        ;PRESERVE OLD
0CD3   85 42               STA PRB        ;STORE NEW
0CD5   09 04               ORA #%00000100 ;RESTORE BIT
0CD7   85 42               STA PRB        ;AND REPLACE IT
0CD9   60                  RTS
0CDA                ;
0CDA                ;
0CDA                ;******** SUBROUTINE MISNG ********
0CDA                ;
0CDA                ;COMPARE THE BATTERY VOLTS WITH 3.0 TO
0CDA                ;SEE IF IT IS STILL IN THE SOCKET
0CDA                ;RETURN SIGN NEG IF STILL THERE
0CDA                ;
0CDA                MISNG
0CDA   A0 4D               LDY #V3X0      ;3 VOLTS
0CDC   A5 16               LDA BATNUM     ;GET BATT NO.
0CDE   20 1A 0D            JSR COMPAR     ;COMPARE A,VOLTS
0CE1   30 0F               BMI MISS01     ;STILL THERE
0CE3   A9 32               LDA #50        ;50 MS. WAIT
0CE5   85 47               STA SETIME     ;SETUP TIMER
0CE7                MISS02
0CE7   24 45               BIT RDTIME     ;TEST FOR TIMEOUT
0CE9   10 FC               BPL MISS02
0CEB   A5 16               LDA BATNUM     ;GET NO. BACK
0CED   A0 4D               LDY #V3X0      ;RESTORE TEST VAL
0CEF   20 1A 0D            JSR COMPAR     ;RETEST IT
0CF2                MISS01
0CF2   60                  RTS
0CF3                ;
0CF3                ;******** SUBROUTINE ADCONV ********
0CF3                ;
0CF3                ;STORE X IN LATCHES AND RETURN THE
0CF3                ;RESULTING MEASUREMENT IN ACC
0CF3                ;
0CF3                ADCONV
0CF3   86 40               STX PRA        ;STORE X
```

```
LINE # LOC     CODE          LINE

0315   0CF5   20 BF 0C                  JSR CLKL        ;LATCH IT
0316   0CF8   A9 C0                     LDA #$C0        ;SET UP MASK
0317   0CFA   85 19                     STA MASK        ;IN ZERO PAGE
0318   0CFC   0A                        ASL A           ;ACC == $80
0319   0CFD   85 40                     STA PRA         ;DRIVE THE DAC
0320   0CFF                  ADTEST
0321   0CFF   20 2F 0D                  JSR DLY         ;ANALOG SETTLE TIME
0322   0D02   24 42                     BIT PRB         ;TEST MSB FOR COMPARATOR STATE
0323   0D04   30 09                     BMI ADINCR      ;BRANCH IF V(DAC) < V(UNKN)
0324   0D06   A5 19                     LDA MASK        ;GET CURRENT MASK
0325   0D08   45 40                     EOR PRA         ;CLEAR CURRENT BIT
0326   0D0A   85 40                     STA PRA         ;AND SET THE NEXT LOWER ONE
0327   0D0C   4C 15 0D                  JMP ADEND
0328   0D0F                  ADINCR
0329   0D0F   A5 19                     LDA MASK        ;GET CURRENT MASK
0330   0D11   05 40                     ORA PRA         ;LEAVE CURRENT BIT SET
0331   0D13   85 40                     STA PRA         ;AND SET THE NEXT LOWER ONE
0332   0D15                  ADEND
0333   0D15   46 19                     LSR MASK        ;SHIFT MASK FOR LOWER BIT
0334   0D17   D0 E6                     BNE ADTEST      ;BRANCH IF NOT DONE
0335   0D19   60                        RTS             ;RETURN WHEN MASK IS EMPTY
0336   0D1A                  ;
0337   0D1A                  ;******** SUBROUTINE CMPDAC ********
0338   0D1A                  ;******** SUBROUTINE COMPAR ********
0339   0D1A                  ;
0340   0D1A                  ;COMPARE THE CONTENTS OF THE Y REG WITH
0341   0D1A                  ;THE ANALOG INPUT ADDRESSED BY THE X REG
0342   0D1A                  ;ALTERNATE ENTRY COMPAR IF ACC=ADDR
0343   0D1A                  ;
0344   0D1A                  ;RETURN:   SIGN=1 IF Y > UNKN
0345   0D1A                  ;          SIGN=0 IF Y < UNKN
0346   0D1A                  ;
0347   0D1A                  ;A,P,Y,LATCH MODIFIED
0348   0D1A                  ;
0349   0D1A                  COMPAR
0350   0D1A   AA                        TAX
0351   0D1B                  CMPDAC
0352   0D1B   A9 16                     LDA #%00010110 ;TO PURGE LEAKAGE
0353   0D1D   85 40                     STA PRA
0354   0D1F   20 BF 0C                  JSR CLKL
0355   0D22   86 40                     STX PRA         ;OUTPUT THE ADDRESS
0356   0D24   20 BF 0C                  JSR CLKL        ;AND LATCH IT
0357   0D27   84 40                     STY PRA         ;OUTPUT THE TEST VAL
0358   0D29   20 2F 0D                  JSR DLY         ;WAIT FOR SETTLING
0359   0D2C   24 42                     BIT PRB         ;TEST THE RESULT
0360   0D2E   60                        RTS
0361   0D2F                  ;
0362   0D2F                  ;
0363   0D2F                  ;******** SUBROUTINE DLY ********
0364   0D2F                  ;
0365   0D2F                  ;EXECUTES A DEAD LOOP FOR (TIME) COUNTS
0366   0D2F                  ;Y,P MODIFIED
0367   0D2F                  ;
0368   0D2F                  DLY
0369   0D2F   A0 0A                     LDY #TIME       ;GET VALUE OF DELAY
```

```
LOC     CODE        LINE

0D31               DLY1
0D31    88                DEY
0D32    D0 FD             BNE DLY1
0D34    60                RTS
0D35               ;
0D35               ;
0D35               ;******** SUBROUTINE SWIOFF ********
0D35               ;
0D35               ;TURN OFF THE CURRENT TO THE BATTERY
0D35               ;ADDRESSED BY THE (X) REG
0D35               ;A,P MODIFIED
0D35               ;
0D35               SWIOFF
0D35    8A                TXA               ;FETCH THE BATT NO.
0D36    29 BF             AND #OFF          ;CLEAR BIT 6
0D38               SWI1
0D38    85 40             STA PRA
0D3A    20 BF 0C          JSR CLKL          ;SHIFT TO LATCH
0D3D    20 C4 0C          JSR CLKS          ;SHIFT TO OUTPUT
0D40    60                RTS
0D41               ;
0D41               ;
0D41               ;******** SUBROUTINE SWION ********
0D41               ;
0D41               ;TURN ON THE CURRENT TO THE BATTERY
0D41               ;ADDRESSED THE THE (X) REG
0D41               ;A,P MODIFIED
0D41               ;
0D41               SWION
0D41    8A                TXA               ;FETCH THE BATT NO.
0D42    09 40             ORA #ON           ;SET BIT 6
0D44    D0 F2             BNE SWI1          ;BRANCH ALWAYS
0D46               ;
0D46               ;
0D46               ;******** SUBROUTINE LEDOFF ********
0D46               ;
0D46               ;TURN OFF THE LED ADDRESSED BY
0D46               ;THE (X) REG
0D46               ;A,P MODIFIED
0D46               ;
0D46               LEDOFF
0D46    8A                TXA               ;FETCH THE BATT NO.
0D47    29 7F             AND #LOFF         ;CLEAR BIT 7
0D49               OFF1
0D49    85 40             STA PRA           ;TO PORT
0D4B    20 BF 0C          JSR CLKL          ;TO LATCH
0D4E    20 CF 0C          JSR CLKI          ;TO LEDS
0D51    60                RTS
0D52               ;
0D52               ;
0D52               ;******** SUBROUTINE LEDON ********
0D52               ;
0D52               ;TURN ON THE LED ADDRESSED BY
0D52               ;THE (X) REG
0D52               ;A,P MODIFIED
```

```
LINE # LOC     CODE        LINE

       0D52                ;
       0D52                LEDON
       0D52   8A                   TXA                ;FETCH THE BATT NO.
       0D53   09 80                ORA #LON           ;SET BIT 7
       0D55   D0 F2                BNE OFF1           ;BRANCH ALWAYS
       0D57                ;
       0D57                ;******** SUBROUTINE TESTON ********
       0D57                ;
       0D57                ;TURN ON THE TEST BATTERY DRAIN
       0D57                ;A,P MODIFIED
       0D57                ;
       0D57                TESTON
       0D57   A9 47                LDA #%01000111 ;BIT 7 SW LATCH ON
       0D59   4C 38 0D             JMP SWI1           ;CLOCK AND EXIT
       0D5C                ;
       0D5C                ;******** SUBROUTINE TSTOFF ********
       0D5C                ;
       0D5C                ;TURN OFF THE TEST BATT DRAIN
       0D5C                ;A,P MODIFIED
       0D5C                ;
       0D5C                TSTOFF
       0D5C   A9 07                LDA #%00000111 ;BIT 7 SW LATCH
       0D5E   4C 38 0D             JMP SWI1           ;CLOCK AND EXIT
       0D61                ;
       0D61                ;****** SUBROUTINE TO SERVICE THE TEST BATTERY ******
       0D61                ;
       0D61                ;TEST VOLTAGE AND HISTORY AND DO INDICATED JOB
       0D61                ;
       0D61                TEST
       0D61   A5 17                LDA TESTAT         ;GET HISTORY
       0D63   29 03                AND #3             ;MASK JUST IN CASE
       0D65   0A                   ASL A              ;TIMES 2
       0D66   AA                   TAX                ;TO INDEX
       0D67   BD 74 0D             LDA TTABL,X        ;PUT VECTOR IN IND JUMP LOC
       0D6A   85 1A                STA JMPLOC
       0D6C   BD 75 0D             LDA TTABL+1,X
       0D6F   85 1B                STA JMPLOC+1
       0D71   6C 1A 00             JMP (JMPLOC)       ;GO DO IT
       0D74                TTABL
       0D74   7C 0D                .WORD FREE,DUMP,DEAD,DEAD
       0D76   92 0D
       0D78   AE 0D
       0D7A   AE 0D
       0D7C                ;
       0D7C                ;CASE FREE ---- NO BATT IN TEST SOCKET
       0D7C                ;
       0D7C                FREE
       0D7C   A5 18                LDA DISPNO         ;
       0D7E   20 AE 0C             JSR DISPLA
       0D81   A9 20                LDA #%00100000
       0D83   25 42                AND PRB
       0D85   F0 08                BEQ FRE1           ;BRANCH IF NO BATT
       0D87   A9 01                LDA #1
       0D89   85 17                STA TESTAT
       0D8B   A9 00                LDA #0
```

```
LINE # LOC    CODE        LINE

0477  0D8D  85 15              STA MIN        ;SET CLOCK
0478  0D8F               FRE1
0479  0D8F  4C 37 0F           JMP DEL        ;EXIT THROUGH DELAY ROUTINE
0480  0D92               ;
0481  0D92               ;CASE DUMP ---- FOUND BATT IN SOCKET
0482  0D92               ;
0483  0D92               DUMP
0484  0D92  A9 DC              LDA #$DC       ;'DISCHARGE'
0485  0D94  20 AE 0C           JSR DISPLA
0486  0D97  20 57 0D           JSR TESTON     ;DISCHARGE IT
0487  0D9A  A9 20              LDA #%00100000
0488  0D9C  25 42              AND PRB
0489  0D9E  D0 0B              BNE DUM1       ;BRANCH IF NOT DEAD YET
0490  0DA0  A9 03              LDA #3
0491  0DA2  85 17              STA TESTAT
0492  0DA4  20 5C 0D           JSR TSTOFF
0493  0DA7  A5 15              LDA MIN        ;GET ELAPSED TIME
0494  0DA9  85 1D              STA BATIME     ;FOR DISPLAY
0495  0DAB               DUM1
0496  0DAB  4C 37 0F           JMP DEL        ;EXIT THROUGH DELAY
0497  0DAE               ;
0498  0DAE               ;CASE DEAD ---- RAN IT DOWN, WAIT REMOVAL
0499  0DAE               ;
0500  0DAE               DEAD
0501  0DAE  A5 1D              LDA BATIME
0502  0DB0  20 AE 0C           JSR DISPLA     ;SHOW IT
0503  0DB3  A9 40              LDA #%01000000
0504  0DB5  25 42              AND PRB
0505  0DB7  F0 04              BEQ DEAD1      ;BRANCH IF NOT REMOVED
0506  0DB9  A9 00              LDA #0
0507  0DBB  85 17              STA TESTAT
0508  0DBD               DEAD1
0509  0DBD  4C 37 0F           JMP DEL
0510  0DC0               ;
0511  0DC0               ;******** SUBROUTINE TO CHARGE ONE BATT ********
0512  0DC0               ;         FOR ONE CYCLE
0513  0DC0               ;
0514  0DC0               ;BATNUM CONTAINS THE NUMBER OF THE BATTERY TO BE
0515  0DC0               ;SERVICED ON THIS PASS
0516  0DC0               ;STAT (BATNUM) CONTAINS THE LAST KNOWN STATUS OF
0517  0DC0               ;THAT BATTERY
0518  0DC0               ;
0519  0DC0               ;THERE ARE FIVE POSSIBILITIES:
0520  0DC0               ;
0521  0DC0               ;  0  NO BATT IN SOCKET:    GOTO NOBATT
0522  0DC0               ;  1  UNKN BATT IN SOCKET  GOTO RDY
0523  0DC0               ;  2  BAD BATT IN SOCKET   GOTO UNSAFE
0524  0DC0               ;  3  GOOD BATT IN SOCKET  GOTO CHRG
0525  0DC0               ;  4  FINISHED             GOTO DONE
0526  0DC0               ;
0527  0DC0               CHARGE
0528  0DC0  A6 16              LDX BATNUM     ;GET THE NEXT BATT NO.
0529  0DC2  B5 00              LDA STAT,X     ;GET STAT FOR THAT BATT
0530  0DC4  29 07              AND #7         ;STRIP TO 3 BITS
0531  0DC6  0A                 ASL A          ;TIMES 2
```

```
 LOC     CODE          LINE

 0DC7  AA                    TAX             ;X=STAT*2
 0DC8  BD D5 0D              LDA JTABL,X     ;GET LO PC FRM TBL
 0DCB  85 1A                 STA JMPLOC
 0DCD  BD D6 0D              LDA JTABL+1,X   ;GET HI PC FRM TBL
 0DD0  85 1B                 STA JMPLOC+1
 0DD2  6C 1A 00              JMP (JMPLOC)    ;DO CASE (STAT)
 0DD5                 ;
 0DD5                 ;
 0DD5                 ;JUMP TABLE FOR  DO CASE (STAT(BATNUM))
 0DD5                 ;
 0DD5                 JTABL
 0DD5  DF 0D                 .WORD NOBATT    ;CASE 0
 0DD7  FF 0D                 .WORD RDY       ;CASE 1
 0DD9  2D 0E                 .WORD UNSAFE    ;CASE 2
 0DDB  50 0E                 .WORD CHRG      ;CASE 3
 0DDD  9E 0E                 .WORD DONE      ;CASE 4
 0DDF                 ;
 0DDF                 ;
 0DDF                 ;---- CASE 0 -- NOBATT ----
 0DDF                 ;
 0DDF                 ;SEE IF A BATT HAS BEEN INSERTED
 0DDF                 ;IF V>7.2 THEN SET STAT(N)=RDY
 0DDF                 ;ELSE DO NOTHING
 0DDF                 ;
 0DDF                 NOBATT
 0DDF  A0 B8                 LDY #V7X2
 0DE1  A5 16                 LDA BATNUM      ;FOR BATT VOLTS
 0DE3  AA                    TAX
 0DE4  20 1B 0D              JSR CMPDAC      ;MAKE TEST
 0DE7  10 15                 BPL NOB1        ;JMP IF V(BATT) < 7.2
 0DE9  A9 32                 LDA #50
 0DEB  85 47                 STA SETIME      ;START TIMER FOR 50 MS.
 0DED                 NOB2
 0DED  24 45                 BIT RDTIME      ;DONE ?
 0DEF  10 FC                 BPL NOB2
 0DF1  A0 B8                 LDY #V7X2       ;RESTORE Y
 0DF3  20 1B 0D              JSR CMPDAC      ;RE-TEST TO DEBOUNCE
 0DF6  10 06                 BPL NOB1
 0DF8  A9 01                 LDA #1          ;MAKE STAT RDY
 0DFA  A6 16                 LDX BATNUM
 0DFC  95 00                 STA STAT,X      ;UPDATE STAT
 0DFE                 NOB1
 0DFE  60                    RTS             ;FINISHED
 0DFF                 ;
 0DFF                 ;---- CASE 1 -- RDY ----
 0DFF                 ;
 0DFF                 ;A BATT IS IN SOCKET
 0DFF                 ;DETERMINE THE TEMP AND SETUP A DUTY
 0DFF                 ;CYCLE LIMIT
 0DFF                 ;IF DUTY CYC IS 0 THEN MAKE STAT UNSAFE
 0DFF                 ;ELSE TURN OFF LED AND MAKE STAT CHRG
 0DFF                 ;
 0DFF                 RDY
 0DFF  20 B6 0E              JSR SETDTY      ;DETERMINE DUTY CYCLE FROM TEMF
 0E02  F0 22                 BEQ RDY1        ;RESULT UNSAFE
```

```
LINE # LOC     CODE       LINE

0587  0E04  A6 16                 LDX BATNUM      ;GET BATT NO.
0588  0E06  20 F3 0C              JSR ADCONV      ;READ BATT VOLTS
0589  0E09  4A                    LSR A           ;V/2
0590  0E0A  85 1C                 STA REG
0591  0E0C  4A                    LSR A           ;V/4
0592  0E0D  4A                    LSR A           ;V/8
0593  0E0E  4A                    LSR A           ;V/16
0594  0E0F  18                    CLC
0595  0E10  65 1C                 ADC REG         ;NOW = 0.612 * VOLTS
0596  0E12  A8                    TAY
0597  0E13  A5 16                 LDA BATNUM
0598  0E15  09 38                 ORA #BTEMP
0599  0E17  20 1A 0D              JSR COMPAR
0600  0E1A  30 0A                 BMI RDY1
0601  0E1C  A6 16                 LDX BATNUM
0602  0E1E  20 46 0D              JSR LEDOFF      ;THURN OFF THIS LED
0603  0E21  A9 03                 LDA #3          ;CASE CHRG
0604  0E23  95 00                 STA STAT,X      ;ENABLE THIS BATT TO CHARGE
0605  0E25  60                    RTS
0606  0E26                RDY1
0607  0E26  A6 16                 LDX BATNUM
0608  0E28  A9 02                 LDA #2          ;CASE UNSAFE
0609  0E2A  95 00                 STA STAT,X      ;MARK THIS BATT UNSAFE
0610  0E2C  60                    RTS
0611  0E2D                ;
0612  0E2D                ;---- CASE 2 -- UNSAFE ----
0613  0E2D                ;
0614  0E2D                ;A BATTERY IS IN THE SOCKET WHICH
0615  0E2D                ;HAS NOT BEEN PROVEN SAFE TO CHARGE
0616  0E2D                ;TEST TEMP UNTIL OK AND BLINK
0617  0E2D                ;THE LED
0618  0E2D                ;
0619  0E2D                UNSAFE
0620  0E2D  20 DA 0C              JSR MISNG       ;REMOVED ??
0621  0E30  30 08                 BMI UNS3        ;BR IF STILL THERE
0622  0E32  A9 00                 LDA #0          ;MARK IT GONE
0623  0E34  95 00                 STA STAT,X
0624  0E36  20 46 0D              JSR LEDOFF
0625  0E39  60                    RTS
0626  0E3A                UNS3
0627  0E3A  20 FF 0D              JSR RDY         ;CHECK TEMP
0628  0E3D  C9 02                 CMP #2          ;STILL UNSAFE ?
0629  0E3F  D0 0A                 BNE UNS1        ;RETURN IF NOT
0630  0E41  F6 0C                 INC BLINK,X
0631  0E43  B5 0C                 LDA BLINK,X
0632  0E45  4A                    LSR A
0633  0E46  90 04                 BCC UNS2        ;ODD/EVEN
0634  0E48  20 46 0D              JSR LEDOFF
0635  0E4B                UNS1
0636  0E4B  60                    RTS
0637  0E4C                UNS2
0638  0E4C  20 52 0D              JSR LEDON
0639  0E4F  60                    RTS
0640  0E50                ;
0641  0E50                ;---- CASE 3 -- CHRG ----
```

```
LINE # LOC     CODE        LINE

0642  0E50                 ;THE BATTERY IN THE SOCKET IS NOW
0643  0E50                 ;BEING CHARGED. WATCH TEMP AND
0644  0E50                 ;VOLTS AND QUIT WHEN DONE
0645  0E50                 ;
0646  0E50                 CHRG
0647  0E50  A6 16                   LDX BATNUM
0648  0E52  20 35 0D                JSR SWIOFF      ;MEASURE WITH NO CURRENT
0649  0E55  A9 0A                   LDA #10         ;AFTER 10 MS DELAY
0650  0E57  85 47                   STA SETIME
0651  0E59                 CHRG01
0652  0E59  24 45                   BIT RDTIME
0653  0E5B  10 FC                   BPL CHRG01      ;LOOP FOR 10 MS
0654  0E5D  20 F3 0C                JSR ADCONV      ;MEASURE THE BATTERY
0655  0E60  C9 E8                   CMP #V9X1
0656  0E62  90 07                   BCC CHRG02      ;BRANCH IF V<9.3
0657  0E64                 CHRG03
0658  0E64  A9 04                   LDA #4          ;CUTOFF ON VOLTS MARK
0659  0E66  A6 16                   LDX BATNUM      ;THIS BATT
0660  0E68  95 00                   STA STAT,X      ;DONE
0661  0E6A  60                      RTS
0662  0E6B                 CHRG02
0663  0E6B  4A                      LSR A           ;0.5 V
0664  0E6C  85 1C                   STA REG         ;SAVE 0.5 V
0665  0E6E  4A                      LSR A           ;0.25 V
0666  0E6F  4A                      LSR A           ;0.125 V
0667  0E70  18                      CLC
0668  0E71  65 1C                   ADC REG         ;0.625*V
0669  0E73  A8                      TAY
0670  0E74  A5 16                   LDA BATNUM
0671  0E76  09 38                   ORA #BTEMP      ;ADDRESS AMB THERM AND BATT
0672  0E78  20 1A 0D                JSR COMPAR      ;COMPARE Y,TEMP
0673  0E7B  30 E7                   BMI CHRG03      ;BR IF TEMP CUTOFF
0674  0E7D  20 DA 0C                JSR MISNG       ;SEE IF BATT REMOVED
0675  0E80  30 0A                   BMI CHRG04      ;STILL THERE
0676  0E82  A6 16                   LDX BATNUM
0677  0E84  20 46 0D                JSR LEDOFF
0678  0E87  A9 00                   LDA #0          ;MARK NO BATT
0679  0E89  95 00                   STA STAT,X
0680  0E8B  60                      RTS
0681  0E8C                 CHRG04                    ;NOW CHARGE ACCORDING TO DUTY
0682  0E8C  A6 16                   LDX BATNUM      ;GET BATT NO.
0683  0E8E  B5 06                   LDA DUTY,X      ;THIS BATT DUTY CYC
0684  0E90  D0 03                   BNE CHRG05      ;BR IF DONE
0685  0E92  20 B6 0E                JSR SETDTY      ;RESET TO NEW VAL
0686  0E95                 CHRG05
0687  0E95  4A                      LSR A           ;BIT 0 THIS CYCLE
0688  0E96  95 06                   STA DUTY,X      ;FOR NEXT PASS
0689  0E98  90 03                   BCC CHRG06      ;LEAVE OFF IF 0
0690  0E9A  20 41 0D                JSR SWION       ;TURN ON IF 1
0691  0E9D                 CHRG06
0692  0E9D  60                      RTS
0693  0E9E                 ;
0694  0E9E                 ;---- CASE 4 -- DONE ----
0695  0E9E                 ;
0696  0E9E                 ;THE BATTERY IN THE SOCKET HAS BEEN
```

```
LINE # LOC      CODE        LINE

0697   0E9E               ;CHARGED AND IS BEING WATCHED FOR
0698   0E9E               ;REMOVAL.  WHEN GONE TURN OFF THE LED
0699   0E9E               ;
0700   0E9E               DONE
0701   0E9E  20 DA 0C              JSR MISNG
0702   0EA1  30 0F                 BMI DON02       ;BR IF STILL THERE
0703   0EA3  A6 16                 LDX BATNUM
0704   0EA5  20 35 0D              JSR SWIOFF      ;TURN OFF
0705   0EA8  20 46 0D              JSR LEDOFF      ;AND TURN OFF LED
0706   0EAB  A9 00                 LDA #0
0707   0EAD  95 00                 STA STAT,X      ;MARK BATT GONE
0708   0EAF  95 06                 STA DUTY,X      ;MARK FOR NEW DUTY
0709   0EB1  60                    RTS             ;NEW MODE = NOBATT
0710   0EB2               DON02
0711   0EB2  20 52 0D              JSR LEDON       ;GREEN LED ON
0712   0EB5  60                    RTS
0713   0EB6               ;
0714   0EB6               ;******** SUBROUTINE SETDTY ********
0715   0EB6               ;
0716   0EB6               ;MEASURE THE TEMP OF BATT (BATNUM) AND
0717   0EB6               ;SETUP DUTY CYCLE(BATNUM) ACCORDINGLY
0718   0EB6               ;
0719   0EB6               SETDTY
0720   0EB6  A6 16                 LDX BATNUM      ;GET BATT NO.
0721   0EB8  20 F3 0C              JSR ADCONV      ;GET THE BATT VOLTAGE
0722   0EBB  4A                    LSR A           ;HALF IT
0723   0EBC  85 1C                 STA REG         ;SAVE TO REUSE
0724   0EBE  A8                    TAY             ;TEST VAL = V/2
0725   0EBF  A5 16                 LDA BATNUM      ;GET BAT NO.
0726   0EC1  09 18                 ORA #BTEM20     ;ADDR R47 AND BATT
0727   0EC3  20 1A 0D              JSR COMPAR
0728   0EC6  10 0B                 BPL SET01
0729   0EC8  A9 FF                 LDA #MSK100     ;100% DUTY CYC OK
0730   0ECA               SETX
0731   0ECA  A6 16                 LDX BATNUM      ;GET BATT NO8
0732   0ECC  25 12                 AND MDUTY       ;INCLUDE XFMR TEMP
0733   0ECE  95 06                 STA DUTY,X      ;ASSIGN TO BATT
0734   0ED0  B5 06                 LDA DUTY,X      ;RCL TO SET Z FLG
0735   0ED2  60                    RTS
0736   0ED3               SET01
0737   0ED3  A4 1C                 LDY REG         ;RECALL VOLTS/2
0738   0ED5  A5 16                 LDA BATNUM
0739   0ED7  09 20                 ORA #BTEM15     ;ADDRESS R48 AND BATT
0740   0ED9  20 1A 0D              JSR COMPAR
0741   0EDC  10 04                 BPL SET02
0742   0EDE  A9 FC                 LDA #MASK75
0743   0EE0  D0 E8                 BNE SETX
0744   0EE2               SET02
0745   0EE2  A4 1C                 LDY REG
0746   0EE4  A5 16                 LDA BATNUM
0747   0EE6  09 28                 ORA #BTEM10     ;ADDRESS R49 AND BATT
0748   0EE8  20 1A 0D              JSR COMPAR
0749   0EEB  10 04                 BPL SET03
0750   0EED  A9 F0                 LDA #MASK50     ;50% DUTY CYCLE
0751   0EEF  D0 D9                 BNE SETX
```

```
LINE # LOC     CODE        LINE

0754   0EF1                SET03
0755   0EF1   A4 1C              LDY REG
0756   0EF3   A5 16              LDA BATNUM
0757   0EF5   09 30              ORA #BTEM05      ;ADDRESS R50 AND BATT
0758   0EF7   20 1A 0D           JSR COMPAR
0759   0EFA   10 04              BPL SET04
0760   0EFC   A9 C0              LDA #MASK25      ;25% DUTY CYCLE
0761   0EFE   D0 CA              BNE SETX
0762   0F00                SET04
0763   0F00   A9 00              LDA #MASK00      ;0% DUTY CYCLE
0764   0F02   F0 C6              BEQ SETX
0765   0F04                ;
0766   0F04                ;
0767   0F04                ;INTERRUPT SERVICE ROUTINE
0768   0F04                ;-------------------------
0769   0F04                ;
0770   0F04                ;12*60=720 INTRPTS PER COUNT ON DISPLAY
0771   0F04                ;FOR DISPLAY TO READ SECONDS:
0772   0F04                ;   DIVIDE 120 HZ LINE CLK BY 10 (12/SEC)
0773   0F04                ;FOR DISPLAY TO READ PERCENT OF ONE HOUR
0774   0F04                ;   DIVIDE 120 HZ LINE CLK BY 6  (20/SEC)
0775   0F04                ;FOR 50 HZ POWER AND PCT READOUT
0776   0F04                ;   DIVIDE 100 HZ LINE CLK BY 5  (20/SEC)
0777   0F04                ;
0778   0F04                ;
0779   0F04                IRQ
0780   0F04   48                 PHA              ;SAVE ACC
0781   0F05   8A                 TXA
0782   0F06   48                 PHA              ;SAVE X REG
0783   0F07   98                 TYA
0784   0F08   48                 PHA              ;SAVE Y REG
0785   0F09   C6 13              DEC TIC          ;1/12TH SEC
0786   0F0B   10 18              BPL IRQ1         ;RETURN IF NO OVFLW
0787   0F0D   A9 0B              LDA #11          ;RESTORE
0788   0F0F   85 13              STA TIC
0789   0F11   C6 14              DEC SECS         ;1 SECOND
0790   0F13   10 10              BPL IRQ1         ;RETURN IF NO OVFLW
0791   0F15   A9 3B              LDA #59
0792   0F17   85 14              STA SECS         ;RESTORE
0793   0F19   A5 15              LDA MIN          ;GET MINUTES
0794   0F1B   C9 99              CMP #$99         ;OVERFLOWED ?
0795   0F1D   F0 06              BEQ IRQ1         ;YES STOP COUNTING
0796   0F1F   F8                 SED              ;DECIMAL MODE FOR MINS
0797   0F20   18                 CLC              ;NO CARRY
0798   0F21   69 01              ADC #1           ;INCREMENT MINS
0799   0F23   85 15              STA MIN
0800   0F25                ;
0801   0F25                ;RESET THE EXTERNAL INTERRUPT FLIP-FLOP
0802   0F25                ;
0803   0F25                IRQ1
0804   0F25   A9 EF              LDA #CLRMSK
0805   0F27   25 42              AND PRB
0806   0F29   85 42              STA PRB
0807   0F2B   A9 10              LDA #IRQMSK
0808   0F2D   05 42              ORA PRB
```

```
LINE # LOC     CODE        LINE

0809  0F2F  85 42                STA PRB         ;INT FF NOW RESET
0810  0F31  68                   PLA             ;RESTORE Y
0811  0F32  A8                   TAY
0812  0F33  68                   PLA             ;RESTORE X
0813  0F34  AA                   TAX
0814  0F35  68                   PLA             ;RESTORE A
0815  0F36  40                   RTI             ;END OF INTERRUPT
0816  0F37                ;
0817  0F37                ;DECIMAL MODE DID NOT NEED TO BE RESET (RTI)
0818  0F37                ;
0819  0F37                ;
0820  0F37                ;IDLE WAITING LOOP MAINLY FOR BLINK RATE
0821  0F37                ;
0822  0F37                DEL
0823  0F37  A9 40                LDA #$40
0824  0F39  85 47                STA SETIME
0825  0F3B                DEL1
0826  0F3B  24 45                BIT RDTIME
0827  0F3D  10 FC                BPL DEL1
0828  0F3F  60                   RTS
0829  0F40                ;
0830  0F40                ;
0831  0F40                ;THIS ROUTINE TESTS THE ROM CYCLIC
0832  0F40                ;REDUNDANCY CODE TO INSURE THE ROM
0833  0F40                ;CONTENTS ARE CORRECT
0834  0F40                ;
0835  0F40                ;SCRATCH AREAS IN RAM DEFINED HERE
0836  0F40                ;
0837  0F40                PTR    = 0
0838  0F40                END    = 2
0839  0F40                TMASK  = 4
0840  0F40                CRC    = 5
0841  0F40                POLY   = $94           ;X↑8 + X↑5 + X↑3 + 1
0842  0F40                GOOD   = $24
0843  0F40                ;
0844  0F40                ENDROM = *
0845  0F40                SYSTST
0846  0F40  A9 00                LDA #<ROMBAS    ;POINT TO AREA TO TEST
0847  0F42  85 00                STA PTR
0848  0F44  A9 0C                LDA #>ROMBAS
0849  0F46  85 01                STA PTR+1
0850  0F48  A9 40                LDA #<ENDROM    ;POINT TO END OF TEST AREA
0851  0F4A  85 02                STA END
0852  0F4C  A9 0F                LDA #>ENDROM
0853  0F4E  85 03                STA END+1
0854  0F50                ;
0855  0F50                ;BEGIN TST LOOP
0856  0F50  A0 00                LDY #0          ;INITIAL INDEX
0857  0F52  98                   TYA             ;COPY
0858  0F53  85 05                STA CRC         ;ZERO THE CRC RESULT
0859  0F55  18                   CLC             ;ZERO CARRY INITIALLY
0860  0F56                ;
0861  0F56                ;BEGIN TEST, LOOP PER BIT AND
0862  0F56                ;LOOP PER BYTE
0863  0F56                ;
```

```
LINE # LOC     CODE        LINE

0864   0F56               CRC00
0865   0F56   A9 80               LDA #$80       ;MSB SET
0866   0F58   85 04               STA TMASK      ;SAVE IN RAM
0867   0F5A               CRC01
0868   0F5A   06 05               ASL CRC        ;MSB OF CRC TO CARRY 0 TO LSB
0869   0F5C   B1 00               LDA (PTR),Y    ;GET A BYTE TO TEST
0870   0F5E   25 04               AND TMASK      ;STRIP ALL BUT MASK BIT
0871   0F60   F0 04               BEQ CRC02      ;BRANCH IF BIT IS ZERO
0872   0F62   B0 0A               BCS NOCHA      ;NO CHANGE IF BIT=1 AND CY=1
0873   0F64   90 02               BCC CHANG      ;   CHANGE IF BIT=1 AND CY=0
0874   0F66               CRC02
0875   0F66   90 06               BCC NOCHA      ;NO CHANGE IF BIT=0 AND CY=0
0876   0F68               CHANG
0877   0F68   A9 94               LDA #POLY      ;FETCH THE POLYNOMIAL
0878   0F6A   45 05               EOR CRC        ;XOR WITH THE RESULT
0879   0F6C   85 05               STA CRC        ;SAVE IT
0880   0F6E               NOCHA
0881   0F6E   46 04               LSR TMASK      ;MOVE TO NEXT BIT
0882   0F70   D0 E8               BNE CRC01      ;UNLESS FINISHED A BYTE
0883   0F72               ;
0884   0F72               ;MOVE POINTER TO NEXT BYTE UNTIL DONE
0885   0F72               ;
0886   0F72   E6 00               INC PTR
0887   0F74   D0 02               BNE CRC03
0888   0F76   E6 01               INC PTR+1
0889   0F78               ;
0890   0F78               ;TEST FOR FINISHED
0891   0F78               ;
0892   0F78               CRC03
0893   0F78   A5 01               LDA PTR+1
0894   0F7A   C5 03               CMP END+1
0895   0F7C   D0 D8               BNE CRC00      ;MSB IS DIFFERENT,CONTINUE
0896   0F7E   A5 00               LDA PTR
0897   0F80   C5 02               CMP END
0898   0F82   D0 D2               BNE CRC00      ;LSB IS DIFFERENT, CONTINUE
0899   0F84               ;
0900   0F84               ;OUT OF BYTES: IS CRC OK ????
0901   0F84               ;
0902   0F84   A5 05               LDA CRC
0903   0F86   C9 24               CMP #GOOD
0904   0F88   F0 03               BEQ RAMCHK     ;ROM CRC IS OK, TST RAM
0905   0F8A   4C AF 0F            JMP FAILED     ;ROM IS BAD -- DIE GRACEFULLY
0906   0F8D               ;
0907   0F8D               ;THIS ROUTINE TESTS THE VALIDITY OF
0908   0F8D               ;THE SYSTEM RAM BY INVERTING AND
0909   0F8D               ;WRITING BACK THE CONTENTS OF EACH
0910   0F8D               ;LOCATION AND TESTING RESULTS
0911   0F8D               ;
0912   0F8D               RAMCHK
0913   0F8D   A2 3F               LDX #RAMSIZ-1  ;SETUP INDEX
0914   0F8F               RAM1
0915   0F8F   8A                  TXA            ;FETCH INDEX
0916   0F90   95 00               STA 0,X        ;WRITE IT IN THE RAM
0917   0F92   CA                  DEX            ;NEXT
0918   0F93   10 FA               BPL RAM1       ;LOOP UNTIL DONE
```

```
LINE # LOC     CODE        LINE

0919  0F95                ;
0920  0F95                ;HERE THE RAM HAS BEEN WRITTEN WITH IT'S OWN ADDRESS
0921  0F95                ;
0922  0F95                RAM2
0923  0F95   E8                   INX                ;  RETURN X TO 0
0924  0F96   8A                   TXA                ;FETCH INDEX
0925  0F97   D5 00                CMP 0,X            ;WAS IT WRITTEN OK
0926  0F99   D0 14                BNE FAILED         ;NO
0927  0F9B   E0 3F                CPX #RAMSIZ-1      ;NEXT
0928  0F9D   D0 F6                BNE RAM2           ;LOOP UNTIL DONE
0929  0F9F                ;
0930  0F9F                ;ADDRESS DECODES OK, NOW TRY INVERTS
0931  0F9F                ;
0932  0F9F                RAM3
0933  0F9F   B5 00                LDA 0,X            ;GET THE BYTE
0934  0FA1   49 FF                EOR #$FF           ;INVERT IT
0935  0FA3   95 00                STA 0,X            ;WRITE IT BACK
0936  0FA5   D5 00                CMP 0,X            ;DID IT WRITE ?
0937  0FA7   D0 06                BNE FAILED         ;NO
0938  0FA9   CA                   DEX                ;NEXT
0939  0FAA   10 F3                BPL RAM3           ;LOOP UNTIL DONE
0940  0FAC                ;
0941  0FAC                ;HERE THE RAM HAS BEEN PROVEN FUNCTIONAL
0942  0FAC                ;
0943  0FAC   4C 40 0C             JMP RESET1         ;RAM AND ROM OK, CONT
0944  0FAF                ;
0945  0FAF                ;HERE THE RAM HAS BEEN PROVEN DEFECTIVE
0946  0FAF                ;
0947  0FAF                FAILED                       ;GET HERE IF ANY RESET TESTS F
0948  0FAF   A9 FA                LDA #$FA
0949  0FB1   20 AE 0C             JSR DISPLA
0950  0FB4   4C AF 0F             JMP FAILED         ;DEAD LOOP --- STAY HERE
0951  0FB7                ;
0952  0FB7                        *=ROMBAS+ROMSIZ-6
0953  0FFA                NMIVEC
0954  0FFA   04 0F                .WORD NMI
0955  0FFC                RESVEC
0956  0FFC   22 0C                .WORD RESET
0957  0FFE                IRQVEC
0958  0FFE   04 0F                .WORD IRQ
0959  1000                        .END

ERRORS = 0000 <0000>
END OF ASSEMBLY
```

```
PASS1
PASS2
ERRORS = 0000 <0000>



SYMBOL TABLE

SYMBOL    VALUE

ADCONV    0CF3    ADEND     0D15    ADINCR    0D0F    ADTEST    0CFF
ATEMP     003E    BATIME    001D    BATNUM    0016    BLINK     000C
BTEM05    0030    BTEM10    0028    BTEM15    0020    BTEM20    0018
BTEMP     0038    CHANG     0F68    CHARGE    0DC0    CHRG      0E50
CHRG01    0E59    CHRG02    0E6B    CHRG03    0E64    CHRG04    0E8C
CHRG05    0E95    CHRG06    0E9D    CLKI      0CCF    CLKL      0CBF
CLKS      0CC4    CLRMSK    00EF    CMPDAC    0D1B    COMPAR    0D1A
CRC       0005    CRC00     0F56    CRC01     0F5A    CRC02     0F66
CRC03     0F78    DEAD      0DAE    DEAD1     0DBD    DEL       0F37
DEL1      0F3B    DISPLA    0CAE    DISPNO    0018    DLY       0D2F
DLY1      0D31    DON02     0EB2    DONE      0E9E    DUM1      0DAB
DUMP      0D92    DUTY      0006    END       0002    ENDROM    0F40
FAILED    0FAF    FRE1      0D8F    FREE      0D7C    GOOD      0024
IOBASE    0040    IRQ       0F04    IRQ1      0F25    IRQMSK    0010
IRQVEC    0FFE    JMPLOC    001A    JTABL     0DD5    LEDOFF    0D46
LEDON     0D52    LOFF      007F    LON       0080    LOOP      0C53
LOOP1     0C69    LOOP12    0C9A    LOOP3     0C77    LOOP4     0C64
LOOP5     0CAB    LOOP6     0C88    LOOP7     0C90    LOOP8     0C98
MASK      0019    MASK00    0000    MASK25    00C0    MASK50    00F0
MASK75    00FC    MDUTY     0012    MIN       0015    MISNG     0CDA
MISS01    0CF2    MISS02    0CE7    MSK100    00FF    NMI       0F04
NMIVEC    0FFA    NOB1      0DFE    NOB2      0DED    NOBATT    0DDF
NOCHA     0F6E    OFF       00BF    OFF1      0D49    ON        0040
POLY      0094    PRA       0040    PRB       0042    PTR       0000
RAM1      0F8F    RAM2      0F95    RAM3      0F9F    RAMBAS    0000
RAMCHK    0F8D    RAMSIZ    0040    RDTIME    0045    RDY       0DFF
RDY1      0E26    REG       001C    RES1      0C27    RES2      0C4B
RES3      0C31    RESET     0C22    RESET1    0C40    RESVEC    0FFC
ROMBAS    0C00    ROMSIZ    0400    SECS      0014    SET01     0ED3
SET02     0EE2    SET03     0EF1    SET04     0F00    SETDTY    0EB6
SETIME    0047    SETX      0ECA    STACK     003F    STAT      0000
SWI1      0D38    SWIOFF    0D35    SWION     0D41    SYSTST    0F40
TABL1     0C03    TABL2     0C08    TEST      0D61    TESTAT    0017
TESTON    0D57    TIC       0013    TIME      000A    TMASK     0004
TMAX      0023    TMIN      0064    TST60     003E    TST70     004A
TST80     0055    TSTOFF    0D5C    TTABL     0D74    UNS1      0E4B
UNS2      0E4C    UNS3      0E3A    UNSAFE    0E2D    V3X0      004D
V7X2      00B8    V9X1      00E8    XTEMP     000F
END OF ASSEMBLY
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